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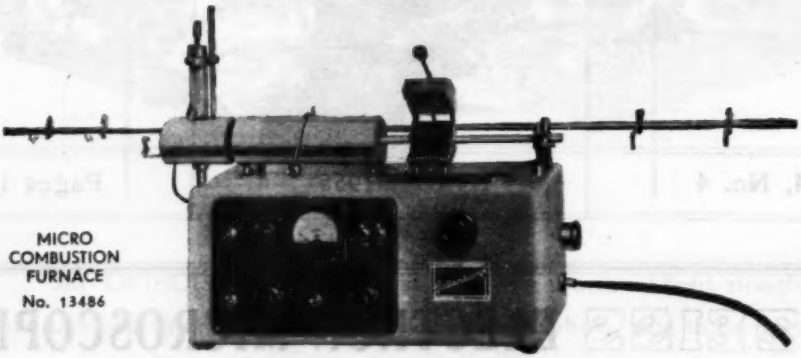

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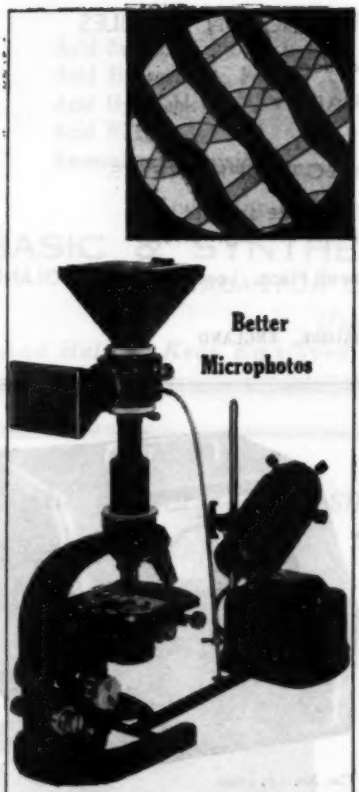

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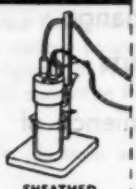

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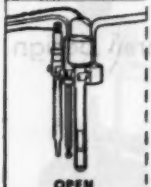

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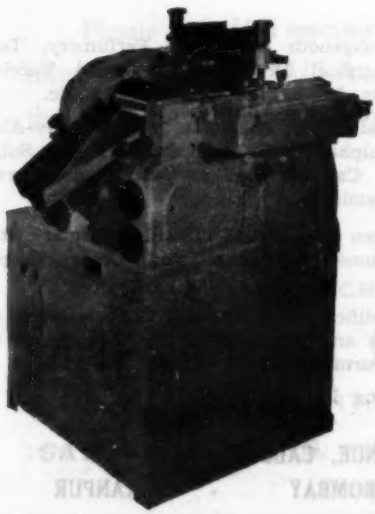

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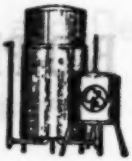

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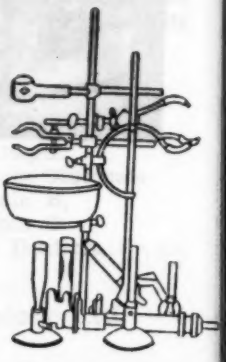

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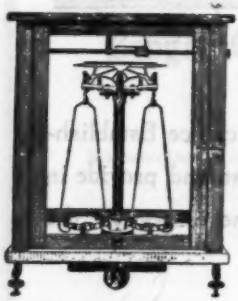

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SCIENCE AND MANKIND*

NUCLEAR physics, including particle physics, remains the principal frontier of advance in physics to-day. It presents a greater challenge to theoretical investigation than any other branch of science and within its field basically new concepts are needed to explain the phenomena observed. But nuclear physics is now the basic science of nuclear energy and of nuclear explosives. It receives greater support from all governments than any other branch of investigation in science. Motives less admirable than the pure search for knowledge of the structure of matter now ensure a continuing and growing interest in nuclear physics. The explosion of the first nuclear weapon did more than usher in a new era in warfare and in the provision of industrial power. It blew to pieces the world of pure research in which Rutherford had spent his life and in which he believed so passionately.

In a less spectacular manner, almost all branches of science are assuming increasing social importance. It seems that all knowledge is applied, sooner or later, both for the benefit of man and for his destruction in war. Mankind is faced with a choice: to use natural knowledge to solve the manifold problems of his continued existence with an increasing standard of living, or to use it to destroy men, the works of their hands, and, worse still, the products of their minds.

Science is the search for truth through natural knowledge. The danger is that in the face of the destruction which can be the fruit of that knowledge, men will turn away from the endeavour to understand nature and seek protection in enforced ignorance. World war with atomic, chemical and bacteriological weapons, waged as all-out conflict, could well provoke a revolt

* Abstract of Rutherford Lecture 1955, delivered by Professor M. L. Oliphant, at Madras, on 25th March 1955.

from science and a return to the primitive bliss of ignorance. Men of science could be wiped out as socially dangerous and the accumulated wisdom of three hundred years could be destroyed overnight.

It is uncomfortable to face up to these problems, perhaps the crucial problems of our time. The great American essayist, Emerson, has written:

> 'God offers to every mind its choice between truth and repose. Take which you please—you can never have both....He in whom the love of repose predominates.... gets rest, commodity and reputation; but he shuts the door to truth. He in whom the love of truth predominates....will abstain from dogmatism....He submits to the inconveniences of suspense and of imperfect opinion, but he is a candidate for truth, as the other is not, and respects the highest law of his being.'

These words reflect the conflict in men's minds to-day. What matters most? The survival of mankind, with his precious heritage of culture and learning, or the victory in war of one ephemeral ideology over another, a hollow victory from which little of value can ever be salvaged? In the name of a cold war men commit all the crimes of their adversaries. Is there any reason to believe that in a shooting war with nuclear and other weapons of mass destruction, men will preserve any moral scruples whatever?

What is Science?

The problems we face to-day have been created by technological applications of scientific knowledge. It is worthwhile, then, to examine the meaning of science and how it affects mankind.

Until about 300 years ago, the normal course of science was the patient observation of nature. Man in general remained a passive agent in the process. With few exceptions the results of such observations were not recorded, although they were incorporated into the lore of the countryside or became part of the traditional knowledge of the craftsmen. Because knowledge was confined almost exclusively to natural events observed by chance, attempts to weave from it any coherent natural philosophy produced intricate, rigid and generally completely erroneous conceptions. These false ideas so obsessed men that they deliberately distorted many elementary observations so that the results fitted into the philosophy popular at the time, or they avoided any conclusions not in accord with belief. For instance, from his very beginnings man must have had a very complete knowledge of the anatomy of animals and men. He dissected both for food or to embalm the dead. Yet it was less than 300 years ago that the English medical man, Harvey, showed that the blood circulated in the body as a result of the pumping action of the heart. Similarly, the Persians made surprisingly accurate observations of the apparent motions of the planets and stars, but were unable to produce other than mystical explanations because they lacked knowledge of mechanics.

The pursuit of knowledge changed its character and was accelerated through the adoption of the experimental method. As a result of this revolution, man became an active participant in the phenomena he observed. The revolution was not without bloodshed, for ancient beliefs had been woven into religion and social behaviour. Many of the revolutionaries paid with their lives for their love of truth. On the whole, mankind is logical and has an inherent respect for integrity, so that the enormous power of the experimental approach was soon recognised. Experiments were devised to test all hypothesis and any theory which did not accord with the results of experiment was discarded. The habits arose of free and open discussion of scientific problems and the results of scientific investigations were published. An ethic of science developed which made discussion and publication obligatory. Thus, as Sir Henry Dale has pointed out to me, Benjamin Franklin, who founded in Philadelphia a society for the discussion of the problems of his time, imposed upon its members an oath, part of which may be paraphrased as follows: "I swear diligently to seek the truth, and having found it, to impart it to others." Scientific knowledge was no longer guarded jealously and recorded in code or in Latin, but became the property of all.

One result of the development of the experimental approach, and of complete openness in science, was that many more men became interested. Science rapidly became a branch of learning with all the dignity and depth of the older disciplines but with far greater vitality. It flowed across national boundaries. There grew up, throughout the civilized world, a body of men devoted to science who, in this matter, were true internationals.

Basic and Applied Science

Scientific activity stretches over a whole spectrum of work, from basic science at one end to the applied sciences like engineering

agriculture and medicine, at the other. There is no sharp division between basic and applied science but rather a gradual merging of one into the other. What is more, applied science is often able to provide tools and ideas for use in research in basic science. The real difference between the ends of this spectrum lies in the motives behind them. Knowledge of nature is sought in basic science which is an activity carried on for its own sake. Applied science, or technology, has an immediate end in view and an investigation is pursued or dropped according to the practical results and profit which can result. Basic and applied sciences are complementary activities and both are essential for increasing knowledge of nature and for the improvement of industry.

In general a considerable period elapses between the making of a fundamental discovery and its successful application for practical purposes. The technological problems associated with the industrial development of a discovery nearly always require more effort and expenditure for their solution than did the original basic research. Thus there are few basic problems remaining to be solved in that part of nuclear physics fundamental to atomic energy, but it will require a decade or two to find solutions to the many technological problems which stand between the fundamental principles and the commercially successful atomic power station.

Use and Misuse of Scientific Knowledge

Science and technology have wrought such a revolution in our way of life that through familiarity with changes we are often indifferent to the full implications of what is happening. For instance, there can be little doubt about the positive benefits which mankind has gained from the development of communications—travel by sea, land and air, printing and the press, the telegraph and telephone, the cinema, radio and television. When properly used, all these modes of communication aid commerce and technological advance, bring peoples of the world closer together, so promoting international understanding and goodwill, and, above all, enable men to share directly their cultural activities and ideas.

The application to medicine of the discoveries of biological science has practically eliminated the threat of death from infectious diseases; technological advances based upon researches in basic science have reduced hard labour and drudgery in almost every walk of life, from the home to the factory and the farm; the yields of produce from agriculture and animal husbandry have increased greatly, the quality has improved and land formerly unfit for farming has come into production; large-scale production methods have brought to the ordinary man much improved standards of housing and of comfort, beauty and entertainment; leisure has increased and education to the highest levels is open to all.

For all these things, which are part of present-day life, men and women who are not blase, disillusioned or soured will give thanks to science and technology. The processes of improvement of knowledge, and hence of its applications, will go on. Already we have before us the prospects of the complete conquest of disease in the very near future, of enormously increased agricultural production and of unlimited energy for all purposes from nuclear processes. Knowledge is available or is being sought which will bring these benefits to all men and help remove hunger, poverty, degradation and despair from the inhabitants of all parts of the world.

These same advances in knowledge, which set so fair a prospect before the eyes of men, bring with them also the possibility of destruction of man and of his civilization. Science, used for individual gain without thought for the consequences, can bring disaster. At the present time we face a crisis in the use of science which is of far greater immediate importance and which must be surmounted if our present civilization is to endure. This is the threat of war which has been for mankind a sort of undulant fever of increasing malevolence which now threatens his very existence. Man stands on the brink of a precipice of his own devising.

Before the advent of the atomic bomb the increasing mechanization of war had introduced new and inhuman characteristics into fighting. The development of "push-button" warfare, whereby a guided torpedo may be launched, a load of bombs dropped or a pilotless guided missile be sent on its deadly mission, had made of war an impersonal and immoral business. A warrior of the past experienced a peculiarly personal relationship with his adversary; skill, physical fitness and bravery were the hallmarks of the victor. What Professor Julius Stone calls the "dehumanizing" of warfare through mechanization has made these qualities of negligible importance. In a future war a girl, sitting at a telephone in a deep dug-out, may misinterpret a message over a bad line with the result that she launches a missile, which will

destroy a city and its million inhabitants. An electrical fault in a complex control network may release such a weapon by accident. Problems of navigation of a high-flying aircraft moving in bad weather to eliminate an industrial target of strategic importance, can lead to the destruction of a neutral city, its inhabitants and priceless treasures. The kind of mistake which occurred again and again in the last war can now have incalculable consequences and in the atmosphere of war is inevitable.

The banning of weapons of mass destruction offers no solution, for any nation facing defeat abandons all scruples and uses every weapon which could decimate the enemy. Excuses can always be found for the use of any diabolical weapon in retaliation. Both sides in the last war were fully armed with the banned weapons of gas and chemical warfare. The only reason that these were not used was that they were not good weapons: it paid to use aircraft to carry explosive and incendiary bombs rather than gas. Atomic weapons were used, and by us.

The wonderfully fruitful field of human endeavour, nuclear physics, which has led to such insight into the structure of matter and which for 50 years had been the preserve of the pure scientist, has assumed over-riding importance as the basis of both unlimited power for the future of man and unlimited powers of destruction of all that he holds dear. The nuclear scientist has come into the limelight in two guises, as the saviour of the Western world from Communist domination and at the same time as the inventor of the diabolic weapons which may destroy civilization.

It is an unfortunate fact that scientific advances yield guns as well as butter. Almost every discovery can be used for evil as well as for good. Even the medical sciences have produced the spectre of bacteriological warfare.

The Responsibilities of the Scientist

The part played by science and applied science in the modern community is so great that the control of activities in these fields can no longer be left to the scientist alone. This statement will sound like heresy to many men of science who believe sincerely in the established conception of complete freedom in the search for truth. In the realm of basic science investigations must continue in an atmosphere of complete freedom, for no one can know from one day to the next, where, how or when the next major discovery will be made, or in what direction the seekers for knowledge will turn tomorrow. Complete freedom does not imply freedom to injure other human beings, to commit acts of cruelty or to neglect the interests of others. The pursuit of knowledge must be governed by the ordinary rules of social conduct.

However, in the applied sciences—and we have seen how difficult it is to draw a line between basic and applied science—the social consequences of development are all important. Ruthless exploitation of men and of raw materials has followed many developments in applied science. Grave dangers can arise to life and to health through the adoption of new equipment or processes which have not been tested thoroughly or which produce unexpected side effects. The deliberate design and development of weapons of destruction is an activity unworthy of science, essential though it may be until a stable state of the world has been established. Activities in these fields must be subjected to social controls.

Technological development proceeds so rapidly that dangers and difficulties arise before external social controls can be established or made effective. Proper supervision can then come only from within the ranks of scientists and technologists. Men of science can no longer deny all responsibility for the uses which may be made of their discoveries or developments. The ethic of social responsibility must be made an integral part of the spirit of the search for knowledge and its applications. Such a feeling is growing rapidly, but it needs to be established on a stronger and more formal basis so that some restraints are imposed upon the ruthless, the cruel or the foolish scientist comparable with those exercised, in theory at least, in the practice of law and medicine.

Finally, it must be recognised that, except in his pursuit of knowledge, the man of science differs in no way from other reasonably intelligent men and women. He is as full of prejudices and failings. He is as much a creature of contradictions, for while he hates the misuse and misrepresentation of science and is irritated and alarmed by secrecy, he is in general passionately loyal. When his country is in danger he is as ready to sacrifice his work and many of his cherished ideals in order to defend her with his knowledge. He is often quite naive and sometimes irresponsible in matters of politics and business. He recognises the greatness and the integrity of men like Rutherford, but does not often reach those heights.

Nevertheless, the real man of science, the seeker after truth, is aware of the paucity of his real knowledge, but has an infinite faith in the ability of man to know and to understand. He experiences humility in the contemplation of the immensity of nature, but he is impressed deeply by the capacity of the human mind. He knows that he is part of nature, but feels that because man can comprehend it, even partially, he must be superior, in some subtle way, to this environment. For him nature has a beauty, a dignity and a reality which transcends even that sensed by the artist, for he apprehends not only with his senses, but with his mind. He knows that knowledge is never certain but that it grows with the efforts of men and so, ultimately, some men may find the truth.

COMBINED CHEMOTHERAPY IN TUBERCULOSIS

OF all the drugs recently found to be effective in the treatment of tuberculosis, isonicotinic acid hydrazide (isoniazid) stands in a class by itself. While not the "wonder drug" that some hoped it might prove to be, three years' experience has fully confirmed the original American reports that it has a remarkable effect *in vitro* and *in vivo* against the tubercle bacillus. It was therefore disappointing when early reports on isoniazid showed that both in the laboratory and in the treatment of patients (especially with pulmonary tuberculosis) tubercle bacilli developed resistance to the drug even more quickly than to streptomycin, and the indiscriminate use of isoniazid alone in the treatment of tuberculosis was generally condemned.

But recently many reports have shown that excellent results can be obtained by suitable combinations of isoniazid with P.A.S. or streptomycin. The latest report of the Medical Research Council, gives further information about the effectiveness of certain of these combinations. Four methods of treatment were compared in 588 patients. All received 200 mg. of isoniazid daily; 182 of them received in addition streptomycin, 1 g. daily (SH), 142 streptomycin 1 g. twice weekly (S2H), 159 P.A.S. 20 g. daily (20 PH), and 105 P.A.S. 10 g. daily (10 PH). Judging solely from the results at three months, streptomycin 1 g. daily *plus* isoniazid 200 mg. daily is not only the most effective of the four treatments, but also represents the most effective drug combination studied at any stage of the trial.

The best combination of these drugs remains uncertain. It is possible that changes in treatment may be more effective than any one combination. But the use of all three drugs together has the disadvantage that resistance might develop to all of them. In this connection two new drugs which show promise are terramycin (oxytetracycline) and pyrazinamide. Terramycin by itself has some activity against the tubercle bacillus, and it is interesting to note that G. B. Mackaness and N. Smith found that, like isoniazid, terramycin was effective in killing tubercle bacilli inside macrophages as well as in the test-tube.

More recently Sheila Stewart, F. W. A. Turnbull and J. W. Crofton have shown that terramycin in the lower doses has little to offer, even in conjunction with isoniazid, but that in a dose of 5 g. daily it does seem to delay the onset of isoniazid resistance. Resistance to terramycin was not observed in any of the groups. The authors themselves suggest that these results are not impressive, but that terramycin may have some place in combination with isoniazid when other drugs for any reason cannot be given.

Some recent American reports suggest that pyrazinamide is more promising. McDermott and his colleagues go so far as to say that pyrazinamide with isoniazid "provides probably the most effective therapy known". Pyrazinamide is a drug of considerable interest. Chemically it resembles nicotinamide, but has a pyrazine instead of a pyridine ring. Like nicotinamide, it is not very active in the test-tube against tubercle bacilli except in special conditions, but showed promise in experimental animals. When first used in man it was found to be too toxic for prolonged administration in effective dosage, but if the recent American reports are confirmed, its combination with isoniazid is an important step forward. (*British Medical Journal*, 1955, p. 465.)

ULTRASONIC VELOCITY AND ABSORPTION MEASUREMENTS IN POLYMER SOLUTIONS

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ULTRASONIC velocity in solutions of *monomers* (vinyl acetate, methyl methacrylate and styrene) in benzene shows a linear variation with concentration in the range of concentrations studied (0-10% by volume), while the absorption decreases rapidly from that of pure benzene as more of the monomer is dissolved but in a normal and steady manner. On the other hand, solutions of *fractionated polymers* in benzene show the peculiar and hitherto undiscovered phenomenon of rapid fluctuations both in velocity and absorption from the values appropriate to pure benzene, as the concentration is varied. This new result first obtained by us in the case of polyvinyl acetate was later found to exist in the cases of polymethyl methacrylate and polystyrene also.

The variation of velocity and (α/f^2) where α is the absorption coefficient, with concentration is plotted for one fractionated polyvinyl acetate sample in Fig. 1. The 'wobbling' of

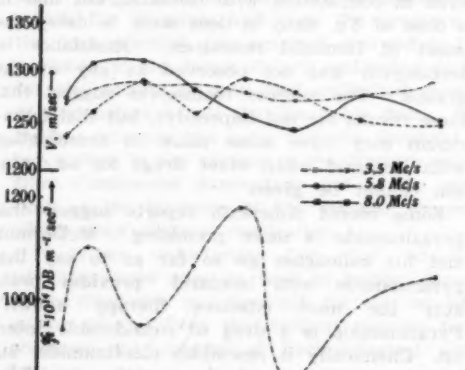

FIG. 1

these factors with concentration is most striking and appears to result from the presence of a number of relaxation frequencies characteristic of the polymer molecule.

Fig. 2 shows the plot of $\alpha\lambda$ (absorption per wavelength) against the frequency, for one

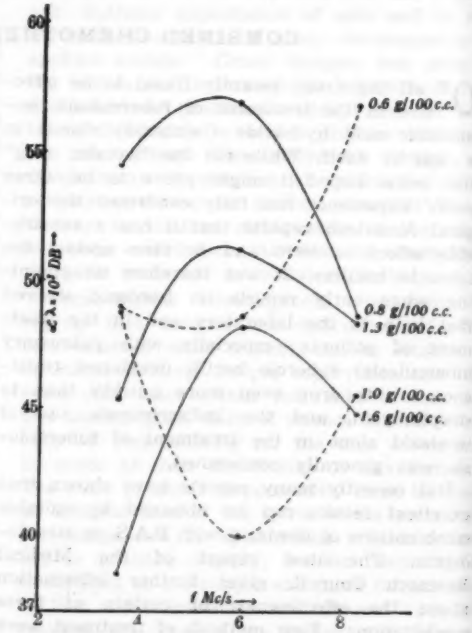

FIG. 2

fraction of polyvinyl acetate as an illustration. Each curve in the graph represents the values for a particular concentration of the solution mentioned alongside the curve. In the range of frequencies studied, there is a frequency at which the maximum for $\alpha\lambda$ is occurring for some concentrations of the solution, while for some others a minimum absorption is observed. The frequency showing the maximum absorption is not the same for all concentrations and is found to vary in an irregular fashion. Fig. 3 shows the variation of velocity with frequency and as in Fig. 2 each curve represents a particular concentration. This graph shows that the velocity is not constant with frequency and also that its variation is erratic. The above results observed in the case of all the different polymer fractions, indicate the presence of

multiple relaxation frequencies. The minima observed for some concentrations in Fig. 2 can only be explained as due to the presence of at least two relaxation frequencies situated very close to each other and on either side of the minimum.

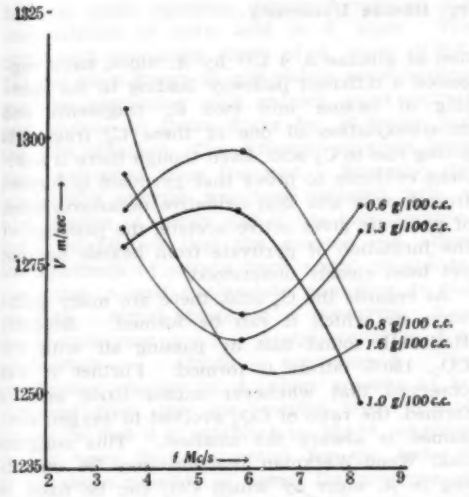

FIG. 3

The above phenomena are however, found to be absent when *unfractionated commercial samples* of polystyrene and polymethyl methacrylate are dissolved in benzene. This is in conformity with the result obtained in polymer fractions, namely, that the peaks and depressions occur in such a closely spaced manner for the different fractions of the same polymer. They are apparently cancelled out by superposition in an unfractionated sample.

Moreover, we have found that unlike benzene which is a good solvent, if a poor solvent like ethyl methyl ketone is chosen and measurements are made on a fraction of each of the above polymers these phenomena are not exhibited at all. This has to be attributed to the lack of freedom to the polymer molecule in a poor solvent to assume different configurations as it is then in a completely coiled state, thereby all the relaxation effects having been suppressed.

The temperature during the course of each of the above experiments has been held constant to within $\pm 0{\cdot}5^{\circ}$ C.

THERMONUCLEAR EXPLOSIONS AND THE WEATHER

THE poor weather experienced in the British Isles and generally in Western Europe in the summer of 1954 came soon after the announcement by the United States Atomic Energy Commission that a series of thermonuclear explosions had taken place in the Pacific. Perhaps not unnaturally, this coincidence caused speculation (unfortunately, often ill-formed and emotional) on the possibility of 'cause and effect'. An attempt has been made by Sutton (*Nature*, 1955, 175, 319) to examine objectively if any grounds exist for suspecting a unique relationship between the man-made disturbances over the Pacific and the weather of mid-1954 in other parts of the world.

Such an investigation is difficult for a variety of reasons. Weather is the first order perturbation of climate and since the weather of 1954 did not exhibit in the British Isles, any features that cannot be paralleled and even exceeded in past years, it follows that any effects attributable to the explosions must be of magnitude not exceeding that of ordinary weather-producing influences. The detection of such additional effects, therefore, demands careful statistical analysis that cannot properly be attempted until several years have elapsed, so that existing climatic 'trends' can be recognized and eliminated. An equally serious difficulty is that, so far, it is not known with certainty how many thermonuclear explosions occurred in 1954; or when and where they all occurred. From press reports it is possible to make what is thought to be a reasonable estimate of the order of magnitude of the energy release in the largest of the Pacific explosions; but almost all other details are lacking.

After examining the evidence from meteorological records, Sutton concludes that both the climatological and aerological evidence are unfavourable to the suggestion that thermonuclear explosions, so far as they are known to have occurred, ruined what might otherwise have been a fine summer. The weather experienced in the British Isles was well within the established climatic range, and taking all facts into account, it is evident that it would be exceedingly difficult, if not impossible, to establish a 'cause and effect' sequence on purely meteorological grounds. What evidence exists points, in fact, to the opposite conclusion.

FORMATION AND ACCUMULATION OF CITRIC ACID IN *ASPERGILLUS NIGER*

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STUDIES on the mechanism of citric acid formation in *A. niger* started as early as 1913 when it was detected in *A. niger* by Zahorski.[1]

Various hypotheses have been formulated for the conversion of the straight chain form of glucose into six carbon acid possessing a branched chain. But the evidence available is not conclusive enough to permit a decision in favour of any one of them. Of all the theories put forward, that of Raistrick[2] deserves discussion, as evidence has been accumulating in recent years to establish the essential principle of his theory. In 1919, Raistrick and Clark[2] suggested that the molecule of glucose, suffering a loss of the element of two molecules of water, together with oxidation at terminal carbon atoms, may give a reactive α, γ diketoadipic acid which, on hydrolysis, should yield acetic acid and oxalacetate, the aldol condensation of the two giving citric acid. Even though sufficient proof has not been obtained for the formation and detection of α, γ diketoadipic acid, recent findings indicate that C_2-C_4 condensation takes place in the formation of citric acid.

Several suggestions have been put forward regarding the C_2 and C_4 acids which take part in citric acid formation. But the recent findings of the author[12–14] suggest that active acetate and oxalacetate are the C_2 and C_4 acids which condense together to form citrate. The pathway of the formation of C_2 acid from carbohydrate is not yet well established. Several workers have felt that the Embden-Meyerhof scheme may be operating, as alcohol and C_2 acid are always found to be present together in the sugar medium in which *A. niger* is grown. But Johnson, Knight and Walker[3] showed that in the presence of 0·002 M iodoacetate, which inhibits the formation of alcohol, citric acid can be produced. Hence they felt that a pathway different from the Embden-Meyerhof scheme may occur. Recently it has been suggested that the Embden-Meyerhof scheme may continue up to the stage of pyruvate which when formed is oxidatively decarboxylated to form acetate.[4] This view has been further strengthened by the recent findings of Jagannathan and Kartar Singh[5] and Shu, Funk and Neish.[6] But Cleland and Johnson,[7] by studying the fermentation of glucose 3, 4 C^{14} by *A. niger*, have suggested a different pathway leading to the splitting of hexose into two C_3 fragments and decarboxylation of one of these C_3 fragments giving rise to C_2 acid. Even though there is sufficient evidence to prove that pyruvate is formed from hexose and that oxidative decarboxylation of pyruvate gives active acetate, the pathway of the formation of pyruvate from hexose has not yet been clearly understood.

As regards the C_4 acid, there are many pathways by which it can be formed. Recently Halliwell[8] found that by passing air with 2% CO_2, 180% citrate is formed. Further it was observed that whenever excess citric acid is formed, the ratio of CO_2 evolved to oxygen consumed is always the smallest. This suggests that Wood-Werkman reaction may be operating in *A. niger* by which CO_2 can be fixed in pyruvate to form oxalacetate. This observation is strengthened by the findings of Foster *et al.*[9] and Martin and Wilson[10] who found that *A. niger* placed on a sugar solution in presence of CO_2 labelled with radioactive carbon produces citric acid with labelled C in carboxyl groups. But the enzyme responsible for Wood-Werkman reaction has not yet been detected in *A. niger*. Similar suggestions have also been made as regards the operation of Thunberg reaction in *A. niger* in which two acetates may condense together to form succinate. But this type of reaction has not yet been established in *A. niger*, and acceptance of this theory has to wait until the appropriate enzyme is isolated and the formation of labelled succinate is confirmed using that enzyme and labelled acetate. There is a possibility of one more pathway for the formation of C_4 acid. While investigating the enzyme systems in *A. niger* during citric acid accumulation, the author observed that the concentrations of α-keto glutaric oxidase and fumarase of the mold increased several folds, and this suggests the possibility of formation of C_4 acid from glutamate.[11] Thus it seems there are many pathways for the formation of C_4 acid.

Several people suggested the occurrence of Krebs' citric acid cycle as the reason for the formation of citric acid in *A. niger*, since the intermediates of Krebs' cycle have been detected at different times. But none of them studied

the stepwise reactions of the cycle. Recently Ramakrishnan and Martin[12] studied the enzymes involved in the formation of citric acid in *A. niger* with a view to find out how far the cycle operates during formation and accumulation of citric acid in *A. niger*. The citric acid producing strain of *A. niger*, N.R.C. 233 has been grown in non-citrate accumulating medium containing malt extract, yeast extract and glucose in shake flasks for 18 hours and the mat obtained. The different enzymes have been extracted from the mat. Recently, the condensing enzyme has been isolated with a high degree of purity and it has been successfully established that the enzyme can affect the synthesis of citrate from acetyl phosphate, coenzyme A and oxalacetate according to the reaction acetyl-phosphate + coenzyme A → acetyl-coenzyme A + P; acetyl-coenzyme A + oxalacetate → citrate + coenzyme A. The condensing enzyme in *A. niger* appears to be different from the one isolated from animal tissues in that it is inhibited by Mg^{++} whereas it has been found essential for the latter.[13] It has been possible to detect the presence of all the enzymes of Krebs' tricarboxylic acid cycle in the cell free extracts of *A. niger*.[4] Thus, evidence for the operation of Krebs' cycle in *A. niger* when grown in a non-citrate accumulating medium has been obtained.

Since the medium used in these investigations is a non-citrate accumulating medium which is different from the one used in industry for large-scale production of citric acid, mold pellets from the actively fermenting molasses medium (in which citric acid is formed and accumulated) were taken out at different periods of citric acid production, the cell free extracts prepared and tested for the presence of the enzymes of Krebs' citric acid cycle. It was found that in the initial stages when no citric acid accumulated, all the enzymes of Krebs' cycle were present and as citric acid started accumulating, aconitase and isocitric dehydrogenase activities became zero. It seems Krebs' cycle enzymes are present in *A. niger* during non-accumulation of citrate and the cycle gets broken down at aconitate and isocitrate levels when citrate starts accumulating in the medium. Even though the reason for the inhibition of aconitase has not been worked out, it is found that addition of excess citrate inhibits isocitric dehydrogenase.[11] From the above discussions, it would seem logical to assume that the formation and accumulation of citric acid in *A. niger* is the net outcome of several reactions like stoppage of operation of Krebs' cycle at a definite stage. Since most of the enzymes required for all these reactions have been detected and many of them purified, it will be possible to study the reactions stepwise, using isotopic and chemical methods, and come to a definite conclusion as regards the mechanism of formation and accumulation of citric acid in *A. niger*.

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'ATOMS FOR PEACE' EXHIBITION

DR. K. S. KRISHNAN, Director, National Phyical Laboratory, declared open the "Atoms for Peace" exhibition in New Delhi on March 10, 1955. The exhibition was organised by the U.S. Information Service with the help of the U.S. Atomic Energy Commission, to illustrate and explain the peaceful uses of atomic energy, depict the various phases of atomic energy development through pictorial panels and charts, miniature working models of Geiger counters, atomic reactors and atomic power plants, and practical uses of various forms of atomic energy. The exhibition will be shown in 50 towns and Universities in India during the next two years.

THE INFLUENZA VIRUS

FOR the last ten or twelve years influenza virus has been a favourite object of study for those who are interested primarily in the nature of viruses rather than in the diseases for which they are responsible. This virus has two qualities which make it particularly suitable for such studies. The first is that it can be grown very readily in the cavities of the chick embryo, the allantoic fluid of which then provides a relatively concentrated and conveniently handled form of virus. A second, and even greater, advantage to the experimenter is that the concentration of virus in such fluids can be accurately and simply titrated in the test-tube by utilizing the virus's power of agglutinating red blood cells—the hæmagglutination phenomenon of G. K. Hirst.

These properties facilitate investigations necessary to establish the physico-chemical nature of the virus particles and to determine, at least in outline, the course of their multiplication in the cell. These investigations have in fact been made, and at least as much is now known about the nature and activities of a typical influenza virus, such as the standard American strain PR 8, as about any other animal virus. As this knowledge accumulated, it gradually became clear that although the particles of influenza virus are well-defined, functional units with characteristic antigenic, enzymic and genetic qualities, chemically they cannot be differentiated from fragments of the cytoplasm of the cells in which they are parasites.

Considered apart from the specific patterns carried by the macromolecules concerned, any type of influenza virus particle is like any other, and distinguishable from a fragment of host-cell cytoplasm only by a moderate regularity of size and shape. Some of the proteins, however, have new specific patterns replacing —or perhaps additional to—the patterns characteristic of host proteins, and we can feel certain that the vital 0·8% of RNA carries a code that differs sharply from that of the cytoplasmic RNA from which it must be derived. The possibility that the large amount of lipid in the particle also has its own series of specific patterns is something that must await the emergence of the appropriate technical approach. On this view, then, the influenza virus is no more than a fragment of living matter carrying patterns—patterns which determine whether the particle is, like most laboratory strains, virulent only for the chick embryo or, at the other extreme, capable of initiating a deadly pandemic-like that of 1918. (*Endeavour*, January 1955.)

OBITUARY

PROFESSOR J. J. ASANA

WE regret to report the death of Prof. J. J. Asana, former Professor of Biology, Gujerat College, Ahmedabad, and late of the Bombay Educational Service, at the age of 64 on December 16, 1954, at Poona.

J. J. Asana was born in Broach on July 30, 1890. After taking the M.A. Degree in Baroda College, he started his career in 1915 as Assistant Professor of Zoology at the Gujerat College, Ahmedabad, where he organised the new zoological laboratory and the museum, and enriched the latter considerably by his skill in Taxidermy. He proceeded to the University of Cambridge, England, in 1922, and took the tripos in Zoology in 1924. On return he occupied himself actively with research and organised a well-equipped cytological laboratory.

Asana's scientific researches were concerned with the life-history and development of reptilia and with the chromosomes of plants, reptilia and orthopteroid insects; his extensive work on orthopteroid insects was reviewed in Demerec's *Advances in Genetics*, Vol. IV, 1951. His zeal for research was an inspiration to his students and colleagues, and he took great pride and spared no pains in making his cytological preparations himself. The latter were greatly appreciated by co-workers in the U.S.A. and Japan, with whom he carried on extensive correspondence with a view to widening the scope of his investigations. In this connexion he also took a short trip to Japan in 1937 at his own expense, and visited several important Institutes and Universities.

Prof. Asana was not only a devoted and selfless seeker after truth, but also a humanist with wide sympathies, transparent sincerity and a kindly, unassuming temperament. He donated his valuable collection of books and scientific journals to the library of the Maharashtra Association for the Cultivation of Science, Poona.

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ISOTROPIC BEHAVIOUR OF ROCKS

In an earlier paper,[1] the author found the directional variation of longitudinal sound velocities in some Indian rocks to be quite small and concluded that they are isotropic for all practical purposes. In the present investigation, using the pulse technique involving the phenomenon of total internal reflection,[2] the directional variation of both longitudinal and torsional ultrasonic velocities has been studied in a number of rocks. Table I gives the results in rock specimens whose planes are chosen to be mutually perpendicular with reference to strike (*a*), dip (*b*), and a direction perpendicular to both (*c*). V_L and V_s are longitudinal and torsional velocities in metres/sec. respectively. P_L and P_s are the corresponding percentage anisotropies.

It can be seen from the results that the percentage anisotropy is of the same order in the

Table I

No.	Rock	Locality		V_L	P_L	V_s	P_s
1	Marble	Manditog	(*a*)	5917		2846	
			(*b*)	6262	1·5	2862	1·8
			(*c*)	6160		2912	
2	Marble	Manditog	(*a*)	7360		3006	
			(*b*)	7260	1·6	3055	2·0
			(*c*)	7477		2995	
3	Quartzite	Warangal	(*a*)	5693		3203	
			(*b*)	5580	1	3092	1·5
			(*c*)	5650		3151	
4	Quartzite	Warangal	(*a*)	7123		3891	
			(*b*)	7296	2	3757	3
			(*c*)	7157		3640	
5	Quartzite	Warangal	(*a*)	6036		3578	
			(*b*)	5913	1	3503	1
			(*c*)	6036		3553	
6	Granite	Hyderabad	(*a*)	6408		2732	
			(*b*)	6210	2	2630	3
			(*c*)	6341		2830	
7	Granite	Hyderabad	(*a*)	6134		2947	
			(*b*)	6015	2	2820	3
			(*c*)	5964		2750	

longitudinal and the torsional velocities. Slight departures from perfect isotropy may be attributed to the heterogeneous nature of the rocks. The results do not indicate a maximum velocity in any one particular direction studied. Thus it is quite evident that elastically, rocks are almost isotropic and this is what one should expect if the rocks are polycrystalline aggregates; where crystallites composing the aggregate are randomly oriented.

The author expresses his grateful thanks to Professor S. Bhagavantam for his guidance in this investigation.

Physical Labs., S. BALAKRISHNA.
Osmania University,
Hyderabad, *January* 21, 1955.

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INFLUENCE OF METEORIC DUST ON RAINFALL

IN a recent paper E. G. Bowen[1] has sought to establish a connection between heavy rainfall and the meteoric showers. He has examined daily rainfall at Sydney for a period of 85 years and has concluded that "there is a marked tendency for heavy falls of rain to occur on certain days rather than on others, and for this pattern to be repeated year after year". By considering the rainfall data of a few other places, he has arrived at a worldwide nature of the supposed connection between meteoric showers and rainfall, *viz.*, that heavy rainfall is likely to occur 30 days ($\pm$ 2) after a meteoric shower. Further it is claimed that this phenomenon has a bearing on artificial rain-making.

Swinbank[2] and Martyn[3] have very critically examined Bowen's contention from different view-points. It is the purpose of this note to find out if the daily rainfall data of Bombay for a period of 51 years (1902-53) supports Bowen's claim. In Bombay the heaviest showers of the year will normally fall in the months of July and August. The daily rainfall for those months for the 51-year period are averaged out and graphs of date against rainfall are drawn, in a manner very similar to what Bowen has done for Sydney rainfall (Figs. 1 and 2). As can be seen from the graphs the days of heaviest fall are: July 3rd, 8th and 21st; August 1st and 7th.

According to Bowen, there should be meteoric showers round about June 3rd, 8th and 21st and July 1st and 7th. So far as it is known to us there is no meteoric shower occurring on these dates. During the period May to August the meteoric showers are:

η Aquarids, May 6th;
δ Aquarids, July 28th.

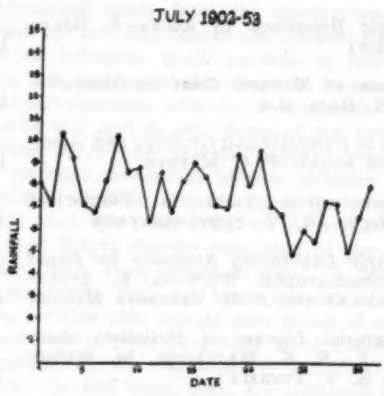

FIG. 1

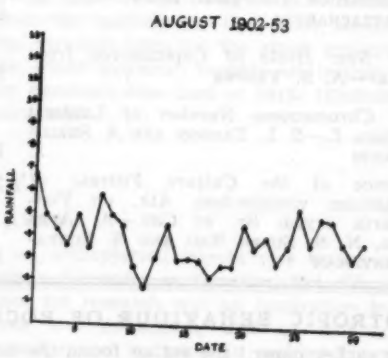

FIG. 2

The claim that many stations over a wide area show peaks similar to Sydney's on nearly the same days, is untenable, at least to Indian conditions, as January and February are about the driest months for most part of the country. This leads us to another issue, *viz.*, when meteoric showers have a significant correlation with rainfall at two or three different places on the earth, statistically there must be a correlation amongst the rainfall figures at these places. Climatologically no such relation has been established amongst rainfalls at widely different places on earth.

Meteors are commonly associated with star constellations. There is a lag of six months between the passage of the sun through a parti-

cular constellation during its apparent motion round the ecliptic and emanation of meteoric shower. No physical process can explain the long delay between the cause and the effect. No type of radiation, be it a wave or particle, can take such long time to travel this distance from sun to earth.

The author wishes to express his gratitude to Mr. S. L. Malurkar for suggesting the work and for his helpful criticism.

Colaba Observatory, K. S. RAJA RAO.
Bombay-5, *January* 24, 1955.

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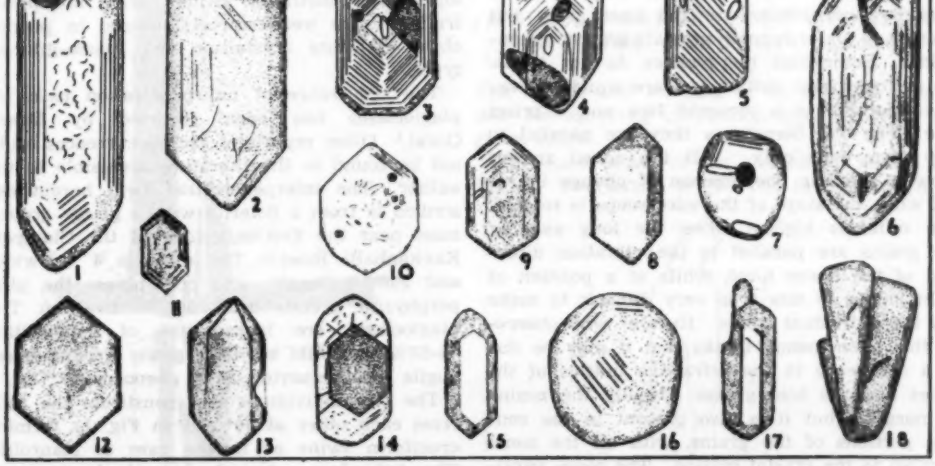
ZIRCON IN BUNDELKHAND GRANITES AND ASSOCIATED ROCKS

THIS paper deals with the variation in habit, size and micro-structure of zircon found in the Bundelkhand granites, associated gneisses, xenolithic quartzites and schists from Mahoba (Lat. 25° 18′, Long. 79° 53′) and adjacent areas in the Hamirpur District, Uttar Pradesh. Misra and Mathur[1] have recorded the presence of apatite, biotite, chlorite, epidote, garnet, hornblende, ilmenite, magnetite, pyrite, rutile, sphene and zircon in the heavy residues of granites and gneisses of Mahoba and Kabrai. Further studies have also revealed the presence of allanite, fluorite, kyanite and tourmaline.

The zircons are colourless, dusky, pale yellow, mauve and pale brownish. Colourless forms are most common followed by dusky variety. Coloured types are infrequent. Usually the zircons are euhedral with perfect development of the various crystal faces. Commonly they show a combination of second order prisms with first order pyramids but first order prisms are not infrequent. Crystals are often much modified by the development of steep pyramidal faces (Figs. 10 and 15). Often the basal planes are also developed in addition to the pyramids. The basal planes may develop on one (Fig. 3) or both of the terminal ends of the grain.



FIGS. 1–18

Fig. 1. Colourless zoned zircon, × 160. Fig. 2. Colourless zoned zircon, × 198. Fig. 3. Colourless zoned zircon with (001) developed at one end, innermost zone a rectangle, × 184. Fig. 4. Colourless and zoned zircon crystal having inclusion of a zoned zircon which in its turn has a prism of zircon as inclusion, × 92. Fig. 5. Colourless zircon with inclusions of needles of zircon arranged parallel to one of the prism and a pyramid face, × 190. Fig. 6. Colourless zoned zircon, × 196. Fig. 7. Dusky zoned rounded zircon containing inclusion of a globular magnetite and two prisms of zircon, × 193. Fig. 8. Colourless unzoned zircon, × 96. Fig. 9. Colourless unzoned zircon, × 100. Fig. 10. Colourless zircon with additional steep pyramids, × 54. Fig. 11. Colouress zoned zircon, × 98. Fig. 12. Dusky zircon, × 126. Fig. 13. Colourless zircon with first order prisms, × 101. Fig. 14. Zircon with an inclusion, × 157. Fig. 15. Zircon with additional steep pyramids, × 57. Fig. 16. Rounded dusky zoned zircon, × 159. Fig. 17. Zircon aggregate in pale yellow variety, × 196. Fig. 18. Zircon aggregate in light brown variety, × 198.

Sometimes prismatic grains with apparently rounded terminations reveal the presence of short pyramidal faces. Among the rounded zircons the dusky variety predominates.

There is great variation in the size of the grains. The length-breadth ratio also varies considerably. It is highest in zircons of granites (3 : 1) and lowest in quartzites and schists (10 : 9). Admixture of grains with high and low 1/b ratios is invariably found but high 1/b ratio zircons predominate in granites while they are subordinate in quartzites and schists. Crystal aggregates (Figs. 17 and 18) have also been noticed. In one of them (Fig. 17) three grains of the pale yellow variety have fused together along their prism faces. Some of the grains are full of minute fractures.

A large number of zircon grains have numerous inclusions of needles of zircons, irregular grains of sphene and opaque clots of iron ores. Zoned zircons have, as a rule, a larger number of inclusions. Fig. 7 shows an oval inclusion of magnetite in a zoned zircon. In some cases zoned crystals show small crystals of zircon (themselves zoned) as inclusions, which in their turn carry another small inclusion of zircon (Fig. 4). Generally, the inclusions are irregularly distributed in the host grain but often they show regular crystallographic orientation. Sometimes the needles do not follow the entire crystal outline and are equally developed parallel to a pyramid face and a prism face (Fig. 5). Sometimes they are parallel to the prism face only. All the zoned zircons show a peculiar phenomenon of change in relief when the stage of the microscope is rotated. The relief is highest when the long axes of the grains are parallel to the vibration direction of the lower nicol, while at a position at right angles to this it is very difficult to make out the individual zones. Hutton[2] who observed this phenomenon thinks that it may be due to a difference in the refractive indices of the zones and the host grains. Usually the zoning is marginal but it is also present in the central portions of the grains, with all the zones parallel to the crystal outline. The zones parallel to the pyramidal faces usually meet at right angles. An extraordinary case has been observed where the innermost zone unlike other zones is a rectangle (Fig. 3). This may be due to the absence of needles developed parallel to the prism faces and since the needles parallel to the pyramidal faces meet at right angles, the north and south set of these needles meet each other in the centre to form the rectangle.

I am highly indebted to Dr. R. C. Misra for his guidance and helpful suggestions.

Dept. of Geology, P. C. MATHUR.
University of Lucknow,
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INTERPENETRATION TWIN IN PLAGIOCLASE FELDSPAR

EXAMINATION of thin sections of the dolerite dykes from Closepet area, Bangalore District, under the microscope revealed the presence of interpenetration twins in the plagioclases. Of about 20 dykes in the area, not less than 8 showed porphyritic texture with glassy or aphanitic ground mass—subophitic to ophitic textures not being uncommon. It is in these dolerites with a glassy ground mass that the interpenetration twins in the plagioclases are more well developed. Specimens taken at the chilled margins, which are more glassy than those taken at the centre, showed well developed interpenetration twins. Such interpenetration twins were scarcely noticed in plagioclases of more crystalline and coarse-grained types.

The occurrence of interpenetration twins in plagioclases has been reported by Masao Gorai.[1] Other reports of such occurrences could not be found in the literature accessible to the author. The interpenetration twin herein described is from a dolerite with a glassy ground mass near the first milestone of the Closepet-Kankanhalli Road. The dyke is 4′ in width and 200′ in length, and cuts across the pink porphyritic granite in N. 50° W. direction. The plagioclases are labradorites of composition 54-58% anorthite set in a glassy ground mass, augite also occurring as a phenocryst.

The two individuals that constitute the twin cross each other at 90° (as in Fig. 1) forming cruciform twins as in the case of staurolite. The twin laws of each individual, the twin plane, as well as the anorthite content were determined on the universal stage according to the method of Reinhard. In other cases, individuals also cross and interpenetrate each other at various angles.

The individuals 1 and 2 (shown in Fig. 2) are twinned after the carlsbad law, 2 and 2′ after the albite law, and 2′ and 1 form an albite-carlsbad complex. The individuals 3 and 4 are related to each other according to

the albite law. The pole of the plane of association (marked AP in Fig. 2) of the four

FIG. 1
Nicols Crossed, × 90.

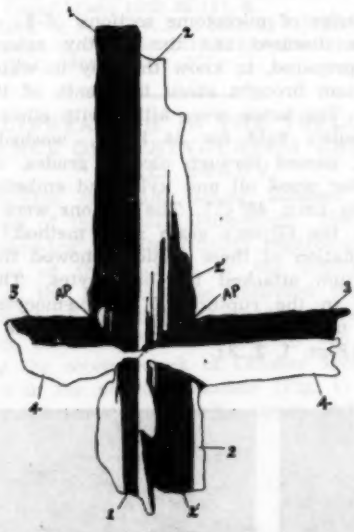

FIG. 2

arms falls on 021 curve of plate 2 of Reinhard, and therefore the association plane is parallel to 021. The poles of the association faces in other instances do not fall on any curve of Reinhard, and may be concluded as being parallel to an irrational pyramid.

Of the four types of twinned plagioclases described by Gorai, penetration twins fall under type 4 of C-twin groups. C-twins, which include albite, carlsbad, and albite-carlsbad laws, are characteristic of volcanic and plutonic igneous rocks, and the plagioclases under study in these dykes are mostly twinned after these laws. The interpenetration twin is often noticed in the chilled dykes of Closepet area. In this area, therefore, the penetration twin in plagioclases appears to be more characteristic of volcanic than of plutonic rocks, as the dykes under study, on account of their chilled nature, have developed under conditions similar to those attained in the volcanic mode of origin of rocks.

Study of twin laws in plagioclases from all the dykes of the area is under progress, and a more detailed account of it will be published elsewhere.

The author is grateful to Dr. P. R. J. Naidu for guidance and to Dr. M. G. C. Naidu for helpful suggestions.

Dept. of Geology, K. V. SURYANARAYANA.
Central College,
Bangalore, *January* 15, 1955.

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A SIMPLE LABORATORY ATOMISER FOR PAPER CHROMATOGRAPHIC WORK

THE design and working of an all-glass atomiser for spraying chromatographic reagents is given below.

The construction of the atomiser is shown in Fig. 1. The nozzle B (3·5 cm. in length) ends

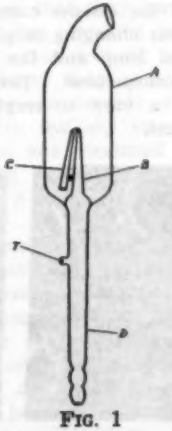

FIG. 1

in an orifice of about 1 mm. A similar small tube C (1 mm. bore and 3·5 cm. in length) is bent at right angles and attached to B by a

glass bead. The bent end of C faces the tip of the orifice B and almost touches it. This unit is sealed to a glass bulb A of about 25 ml. capacity. About 10 ml. reagent can be introduced into the chamber.

Compressed air is blown from the bottom tube D. The pressure of the air current can be regulated through the side outlet T by closing it with the thumb. When the air is forced out of the orifice, the tube C sucks the liquid present in the chamber and the air-jet atomises the liquid drop. A fine spray issues continuously through the mouth of the bulb A. The present model effects economy of the reagent and even corrosive reagents can be sprayed as the atomiser is of all-glass construction. The sprayer is simpler and less expensive than the conventional atomisers of the 'Concentric' and the 'Right-angled' types described in literature.

The authors wish to express their grateful thanks to Prof. K. R. Krishnaswami for his kind encouragement and advice.

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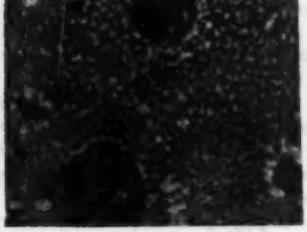
Dept. of Gen. Chem.,
Indian Inst. of Science,
Bangalore, *January* 24, 1955.

A BACTERIAL DISEASE OF *HELIOTHES OBSOLETA* F.

A SEVERE attack of *Heliothes obsoleta* F. (Lepidoptera) was noticed in the *Dolichos lablab* crop of 1953-54 around Mysore. A close survey revealed a large number of the insect larvæ dying due to a disease in these fields. The symptoms of the disease comprised of the normal green colour changing to pink, the body becoming soft and limp and the dorsal blood vessel becoming conspicuous. The disease was investigated with a view to employ it in the control of the insect.

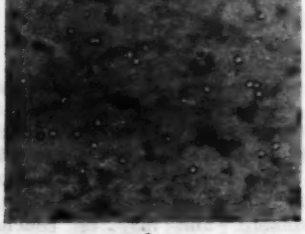
To know whether the disease was caused by some micro-organisms a large number of healthy and diseased caterpillars were surface sterilized and their different body parts were examined. The blood of the diseased insects showed the presence of a bacterium in it which could not be observed in the healthy ones. This bacterium was therefore isolated by the usual bacteriological methods. Subcultures were made on nutrient agar slants and nutrient broth incubated at 31° C. for 48 hours. The pathogenicity of the bacterium was then tested by suspending it in physiological saline solution and spraying the suspension on *D. lablab* pods in the laboratory. These tests were carried out under aseptic conditions. The healthy larvæ feeding and moving on the treated pods showed symptoms of the disease in 48 hours and died in 72 hours. The bacterium could be recovered from the blood of the larvæ exposed to the treated pods. Later tests showed that contact of healthy larvæ with the diseased ones also could produce the disease in the healthy ones. These demonstrated that the disease was caused by a bacterium and that it is contageous.

A series of microtome sections (6-8 μ thick) of the diseased and the healthy caterpillars were prepared, to know the way in which the bacterium brought about the death of the insects. The larvæ were killed with ether, fixed in Bouin's fluid for 24 hours, washed with water, passed through alcohol grades, cleared in ceder wood oil and xylol and embedded in paraffin (m.p. 48° C.). The sections were stained by the Glynn's gram stain method.[1] The examination of these sections showed that the bacterium attacked the hæmocytes. This resulted in the rupture of the hæmocytes and when most of them were destroyed the larvæ died (Figs. 1, 2, 3).



1

2



3

FIG. 1. Blood of healthy *H. obsoleta* showing hæmocytes, × 750. FIG. 2. Hæmocytes in the blood ruptured as a result of the attack by bacteria, × 750. FIG. 3. Hæmocytes of the blood destroyed and the bacteria freely multiplying in the septicemic blood, × 750.

The bacterium is gram positive, motile, rods in chain and sporulating. Studies on the identification of the organism are in progress and will be reported shortly.

Bacterial control of insects is being investigated recently. The works of Hall[2] relate to the high susceptibility of the Sod webworm (*Crambus mutalibilis* Cl.) to *Bacillus thuringiensis* and of Philips *et al*,[3] to the susceptibility of the codling moth (*Carpocapsa pomonella* L.) to *B. cereus*. From India, mycoses in insect pests are reported[4,5] but not the bacterial diseases. The above work suggests the possibility of controlling *H. obsoleta* by employing bacteria.

The authors' thanks are due to Dr. V. Subrahmanyan, for his help and interest in the work.

Central Food Tech. Res. Inst., Mysore, *November* 5, 1954. S. K. MAJUMDER. M. MUTHU. S. V. PINGALE.

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PROLIFERATION IN THE INFLORESCENCE OF *ECHINOCHLOA CRUS-GALLI* BEAUV.

Echinochloa crus-galli Beauv. belongs to the *Paniceæ* of the family *Gramineæ*. The specimen showing the abnormality regarding proliferation of the rachilla or the inflorescence axis of the spikelet, was collected from the rice field of the State Agricultural Research Station, Chinsura, West Bengal, by the author during the second week of October 1953.

Here in the normal spikelets (Fig. 1) which are two-flowered (containing upper and lower

FIG. 1. A normal 2-flowered spikelet shown in detail, florets), the lower floret is male consisting of 3 stamens. The two empty glumes, lower and upper (Glumes I and II) are very dissimilar and undulated. The lower floret is paleated. The upper floret is hermaphrodite, beyond which the rachilla is not produced.

The abnormal entire inflorescence of this grass resembles the normal one in all respects except that it bears in place of certain spikelets one long, one medium and three small proliferated spikelets. These shoots are described as propagules or proliferations which project out quite conspicuously from the axis of the inflorescence. The size of the shoots varies from 6-21 mm. and maximum number of proliferated spikelets observed here is five. When the medium-sized proliferated spikelet was dissected (Fig. 2), it was observed that the structures and their positions of insertion in the rachilla were the same as that of the normal one, excepting that they have increased considerably in size, forming leaf-like structures in appearance but without any leaf-sheath or ligule. The lower floret consists of one stamen and the upper one consists of two stamens and the pistil with feathery stigma. The rachilla was elongated and measured about 2·2 mm. It was produced beyond the upper floret measuring about 2·5 mm. It was terminated by a flower bud.

FIG. 2. A proliferated spikelet showing the proliferation of the rachilla beyond the upper floret.

The abnormalities described here consist of vegetative shoots developing in place of spikelets. This phenomenon was interpreted differently by different authors.[1-5,8] As the abnormal spikelets were very few in number and were found only in one inflorescence out of six tillers of the plant, no systematic investigation could be done to find out the cause or causes of the proliferation. But, according to Arber,[1] proliferations are of two types—one is brought about by environment and the other

by chromosomal and hereditary causes. Nielson,[6] Reeves and Stansel,[7] however, viewed this as due to environmental factors only. Very recently Wycherley[8] has stated that the degree of floral and vegetative development is conditioned by the concentration of a flower-inducing hormone F (or the intensity of some condition), at the time of initiation and differentiation of the inflorescence organs.

Proliferation of this type gives an indication that the spikelets have the tendency of becoming many flowered with the continuous elongation of the axis beyond the upper floret like that of the *Hordeæ*, the *Triticeæ*, etc. The present is perhaps the first report of an abnormality in *E. crus-galli* Beauv.

State Agric. Res. Station, R. K. BHATTACHARYYA.
Chinsurah, Hooghly,
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SOME NEW HOSTS OF *CEPHALEUROS* FROM BIHAR

SOME hosts of *Cephaleuros*, new to Bihar, were reported previously by the author.[1] Since then some more collections of the alga have been made both on wild and cultivated plants from different parts of the State. The hosts collected have been deposited in the mycological herbarium, Botany Department, Patna University.

A careful study of well stained hand-cut sections revealed that the alga on *Aganosma caryophyllata* G. Don. is parasitic as a portion of it is intramatrical. But in the case of the hosts recorded below, the alga is only epiphytic, using the leaf-surface merely as support, though of course in severe cases when the foliage is heavily covered with algal lesions, it may induce rapid defoliation.

PATNA.—*Ficus nervosa* Roth., *Sterculia alata* Roxb., *Cassia fistula* L., *Ficus religiosa* L., *Bombax malabaricum* Dc., *Cæsalpinia crista* L., *Morinda tinctoria* Roxb., *Zizyphus jujuba* Lamk., *Erythrina suberosa* Roxb., *Artocarpus integrifolia* L., *Pyrus malus* L., *Lagerstrœmia indica* L., *Tectona grandis* L., *Tecoma stans* L., *Eriobotrya japonica* Lindl., *Dalbergia latifolia* Roxb., *Trewia nudiflora* L.

PURNEA.—*Bauhinia variegata* L., *Ficus benghalensis* L., *Morus alba* Bureau,

BHAGALPUR.—*Cassia javanica* L.

PARASNATH HILLS.—*Nyctanthes arbor-tristis* L., *Combretum decandrum* Roxb., *Bassia latifolia* Roxb., *Ixora undulata* Roxb., *Buchanania latefolia* Roxb.

The author wishes to express his grateful thanks to Dr. R. P. Roy for giving necessary facilities and Sri. J. G. Srivastava for kindly identifying a number of hosts.

Dept. of Botany, A. S. YADAVA.
Patna University,
Patna, *January* 22, 1955.

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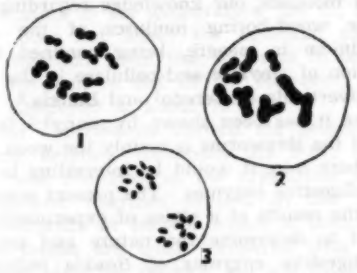
BASIC CHROMOSOME NUMBER OF *LANTANA CAMARA* L.

Lantana camara L. is a native of tropical America. According to Duthie,[1] the plant appears to have been introduced into Ceylon about the year 1824, and from there to have spread throughout Peninsular India and northwards as far as Dehra Dun. The plants of *Lantana camara* L. are characterized[1–6] by the presence of recurved prickles on the stem, short capitate spikes which appear subumbellate when young, lanceolate bracts, 3-5-ribbed stem and a strong smell of black currant. The plant whose chromosome number is being reported in this paper has all these characters except that the stem of this plant has small prickles which are sparingly present. According to Haines,[5] some forms of *Lantana aculeata* (= *Lantana camara* L.) have very minute prickles and according to Bailey,[6] some types of *Lantana camara* L. may even be unarmed or slightly prickly.

The basic chromosome number (x) is the lowest haploid number in a polyploid series. Singh[7] reported the haploid (n) number of *Lantana camara* L. as 22. Sen and Sahni[8] noted the natural occurrence of triploids ($2n = 33$), tetraploids ($2n = 44$) and pentaploids ($2n = 55$) in the same species. The presence of a plant with $2n = 22$ in this species has not been reported. While studying meiosis in *Lantana camara* L., the authors found a plant which at diakinesis showed 11 bivalents (Figs. 1 and 2). The distribution of the chromosomes at anaphase I was regular and 11 chromosomes at either pole were clearly seen (Fig. 3). This

plant with $n = 11$ has the lowest haploid number in the naturally existing polyploid series of *Lantana camara* L. Our findings thus show that the basic chromosome number (x) of *Lantana camara* L. is 11. In view of these



FIGS. 1. (× 713) and 2 (× 1,125). Diakinesis showing 11 bivalents. FIG. 3. (× 713). Anaphase 1 showing 11 chromosomes at each pole.

findings the plant with $n = 22$, as reported by Singh,[7] must have been at a tetraploid level. The existence of a naturally occurring polyploid series in *Lantana camara* L. may be either due to the original introduction of the different chromosome races of this species or that the plants of *Lantana camara* L. may have undergone natural variation and evolution in India. Patermann[9] reported the chromosome number of *Lantana trifolia* L. as $n = 24$. In view of the present report of the basic chromosome number of *Lantana camara* L. as 11, the presence of a species with $n = 24$ in the genus *Lantana* indicates that this genus has either more than one basic chromosome number or the presence of aneuploidy.

We are grateful to Prof. P. Maheshwari for having gone through the manuscript and for his useful suggestions.

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INFLUENCE OF THE CULTURE FILTRATE OF *FUSARIUM VASINFECTUM* ATK. ON *PIRICULARIA ORYZAE* BR. ET CAV.

THE presence of a thermostable growth-promoting factor as one of the metabolites of *Fusarium vasinfectum* Atk. in culture has been shown by the rooting of cut shoots of cotton in dialysed and autoclaved culture filtrate of the fungus.[1] The dialysed and autoclaved culture filtrate from the same strain of *F. vasinfectum* was added to 50 ml. of Richard's liquid medium (adjusted to pH 6·0) and inoculated with an isolate of *Piricularia oryzæ*, known to be heterotrophic to thiamine and possessing complementary deficiency for biotin.[2] The cultures were incubated at 27-28° C. for three weeks. Increased growth over the control was recorded which, however, was less than that obtained in Richard's liquid medium with added thiamine (Table I).

TABLE I

Treatment	Mat weight in mg. of *P. oryzæ* at the end of three weeks (Average of three replicates)
Culture filtrate of *F. vasinfectum* added to Richard's medium	130·0
1·0 µg. of thiamine + Richard's medium	263·0
Control (pure Richard's medium)	Nil

Although not strictly comparable, it is suggestive of the possibility of the dialysed and autoclaved culture filtrate of *F. vasinfectum* having thiamine replacement value—a point of considerable interest in understanding the physiology of fungi autotrophic and heterotrophic to B vitamins.

We are indebted to Prof. T. S. Sadasivan for guidance and to Dr. C. V. Subramanian and Shri K. Lakshminarayanan for suggestions.

Botany Lab., A. APPA RAO.
University of Madras, N. S. SUBBA RAO.
Madras-5, S. SURYANARAYANAN.
February 2, 1955.

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ENDOPHYLLUM SPECIES ON *ELAEAGNUS LATIFOLIA*

Aecidium elæagni-latifoliæ Petch, parasitising the leaves of *Elæagnus latifolia*, is widely distributed in the hilly tracts of Mahableshwar, Bombay State.[3] The rust incites the formation of pale yellow patches on the upper leaf-surface, bearing white æcial pustules on the lower leaf-surface. Owing to the metallic lustre of

the silvery scales on the lower leaf-surface, the white æcial pustules are often inconspicuous in the field. During the heavy monsoon rains in Mahableshwar from June to September (over 250") the æcial pustules are not well developed, but only scattered infection spots are observed. From November onwards, the pycnial stage begins to appear conspicuously on the upper leaf-surface as tiny orange specks, followed by æcial formation, which may be abundantly seen from February to May.

Pycnia are subepidermal, honey-yellow, flask-shaped, ostiolate, with poorly developed periphyses. The æcia are telioid, subepidermal, erumpent, white, peridiate, developing chains of hyaline spores. The peridia are strongly developed, reflexed, the cells being densely rugose, measuring 25-32 × 19-20 μ. The æciospores are subglobose to polygonal, densely verrucose, measuring 15-24 × 12-19 μ.

The æciospores germinate readily developing promycelia and sporidia, thus pointing out that the rust is a species of *Endophyllum*. Spore germination is considerably influenced by temperature. The spores germinate best between 70-85° F. developing promycelium and sporidia. Above 85° F., germination is abnormal, developing a septate germ tube with irregularly lobed contour. Spore material stored at room temperature (60-90° F.) loses its viability after a week.

Sporidial inoculum prepared by germinating æciospores was used for inoculating young unfolding leaves of *Elæagnus latifolia*. The inoculated plants were incubated in moist chambers for 24 hours after which they were placed in the green-house for further observations. Successful infection became evident after 15 days by the development of yellow spots enlarging into patches. Pycnial formation was observed nearly after a month.

The germination studies have indicated that the rust previously designated *Aecidium elæagni-latifoliæ* Petch[1,2] on *Elæagnus latifolia* is a species of *Endophyllum*. Therefore, the new combination *Endophyllum elæagni-latifoliæ* (Petch) Gokhale, Thirumalachar and Patel is proposed for its accommodation.

Agric. College, Poona, *February* 2, 1954.

V. P. Gokhale.
M. J. Thirumalachar.
M. K. Patel.

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THE DIGESTIVE ENZYMES OF *BANKIA INDICA* NAIR

While the physiology of digestion and the digestive enzymes have been studied in a number of molluscs, our knowledge regarding those of the wood-boring molluscs of the family Teredinidæ is meagre, being confined to the detection of amylase and cellulase in the digestive diverticula of Teredo[1] and Bankia.[2]

Since it has been shown by many[3-5] that the diet of the shipworms is mainly the wood which they bore into, it would be interesting to study their digestive enzymes. The present note deals with the results of a series of experiments conducted to determine the nature and action of the digestive enzymes of *Bankia indica*, the commonest of the shipworms infesting the fishing floats in the Madras waters. Acetone dried and distilled water extracts were made, using the digestive diverticula and crystalline style, as per standard methods.[6] The activity of the enzymes on carbohydrates was determined by methods used by Yonge[7] and Somogyi.[8] The products of protein digestion were estimated by Sørensen's formol titration method and products of fat digestion by the direct titration of the fatty acid formed with sodium hydroxide solution using phenolphthalein as the indicator. The cellulolytic activity of the style was studied by using regenerated filter-paper, prepared by the method of Scales[9] and the utilisation of cellulose was followed turbidometrically in photoelectric absorptiometer. In all enzymic experiments the pH of the medium was controlled by suitable buffers, *viz.*, Sørensen's M/15 phosphate buffer pH 5·3 to 7·7 for carbohydrates, M/10 citric acid, M/5 sodium phosphate buffer of McIlvaine, pH 3 to 6·6 followed by 0·2N phosphate-sodium hydroxide buffer of Britton and Welford pH 6·6 to 12·2 for protein and the method adopted by Nicol[10] for fat digestion. The temperature was maintained by an electrically controlled thermostat.

The results of these experiments showed that the digestive enzyme system of *Bankia indica* is effective on carbohydrates, fats and proteins. It was found that the digestive diverticula contain a strong enzyme system which can hydrolyse a variety of carbohydrates like starch, glycogen, sucrose, maltose, lactose, cellobiose, gum arabic, saw dust and regenerated filter-paper more in an acid medium (pH 5·9 to 6·5). The activity-pH curve when plotted for the action of amylolytic enzyme showed that the digestive activity is at its maximum at pH 6·2. The optimum temperature for amylase activity is about 33° C. A series of experiments to deter-

mine the relation between duration of the experiment and optimum pH showed that the pH at which digestion is optimum is not altered when the period of incubation is continued from 5 to 10 and 16 hours. Further, it was observed that variation in the temperature (24° C., 32° C., 42° C.) does not affect the optimum pH for starch digestion. Amylase is found to be destroyed between 60 and 65° C. However, cellulase is destroyed at about 70° C.

Similar experiments showed the presence of a strong amylase (optimum pH 5·9), glycogenase and cellulase, in the crystalline style. The lipolytic enzymes present in the digestive diverticula of *Bankia* which is principally a wood feeder are weak compared with those of typical plankton feeders, but are capable of acting on a wide range of lipids like lecithin, olive oil and methyl acetate. Thus there is a definite correlation between the nature and strength of the digestive enzyme and the feeding habits of the animal. The optimum pH of the lipolytic enzyme is found to be 7·3 and the enzyme is destroyed at 65-70° C.

The protease present in the extracts of the digestive diverticula though weak as in other lamellibranchs, is capable of splitting different types of proteins (gelatine, fibrin, peptone, casein) into simpler amino acids. The results of experiments with gelatine as substrate showed that the protease possesses two optimal pH values, pH 4·6 and pH 8·5 which are in close accordance with the results on the protease of *Ensis siliqua* by Graham.[11] The protease is destroyed completely at 70° C.

Filter-paper chromatographic detection of the end products of cellulose degradation by enzymic action by spotting the hydrolysate, when developed at 100° C. for 5-7 minutes with benzidine developer,[12] the migrating solute appeared as brown spots of varying intensity and demonstrated the concentration of sugars present. After developing the chromatogram the R_f of each spot produced by the unknown was compared with those of known sugars. Cellobiose and glucose were easily detectable in the hydrolysate indicating cellulase activity.

A fuller account will be published elsewhere.

My thanks are due to Prof. C. P. Gnanamuthu, for suggesting the problem and to Prof. P. S. Sarma and Dr. E. R. B. Shanmugasundaram of the Biochemistry Laboratory for facilities and guidance during this work.

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AN ABNORMALITY IN THE ARTERIAL SYSTEM OF *RANA HEXADACTYLA*

In one of the dissections of the arterial system of *Rana hexadactyla* carried out in the laboratory, an interesting case of abnormality was observed revealing the following features: (i) The whole truncus arteriosus turned to the left and gave off the usual arches of that side with no arch to the right (Fig. 1). (ii) The

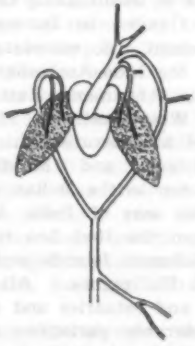

FIG. 1

systemic arch, nevertheless, was present on the right side associated as usual with the sympathetic nervous system and the subclavian artery.

This anomaly may be due to abnormality in the changes of the arterial system during metamorphosis. It is possible that the fourth (systemic) aortic arch of the right side lost its connection with the heart. The sixth (pulmonary) aortic arch, while losing its connection with the heart, retained its connection with the fourth arch (systemic); i.e., the ducts arteriosus of the right side is persistent in the adult.

That there is a regular pulmonary circulation on the right side is evident from the normal condition of the right lung. This may be made possible by the flow of blood into this organ through the abnormal systemic which in turn is supplied by the systemic of the other side. The forward flow of blood in the right systemic is not impossible in the absence of flow into it from the heart and in the absence of valves in arteries in general. The blood supplied to this lung, of course, is drained by the right tributary of the pulmonary vein.

I am thankful to Mr. P. K. Menon, of the Presidency College, for valuable suggestions in arriving at this explanation.

Zoology Dept., B. N. RAMAMURTHI.
Loyola College, Madras-6,
January 18, 1955.

OCCURRENCE OF *SILLAGO CHONDROPUS*, BLKR., IN THE SEAS OF INDIA

AMONG the principal estuarine fishes of our coast, the family Sillaginidæ has been so far represented by three species, namely, *S. panijus*, Day, *S. maculata*, Quoy and Gaim, and *S. sihama*, Forskal, as recorded by Day.[1] Of these, *S. panijus* is known to occur in shoals along the Coromandel coast, in the Ganges, in Burma and in the Malay Archipelago. *S. maculata* has a wide distribution in the Indo-Australian Archipelago, occurring along Andamans, East Africa, New South Wales, West Australia, Philippines and China. Herre[2] has recorded this species from the Long Island and Middle Andaman. *S. sihama*, known as the Indian whiting, being common in the seas of India, is also widely distributed from the Red Sea to East Africa, Queensland, Solomon Islands and Japan north to Tokyo and Philippines. All these species occur in seas and estuaries and can, therefore, tolerate considerable variations in salinity.

In the State of Bombay, *S. sihama* is the only species of this genus known for its common occurrence. Since 1950, studies on the biology of this species have been undertaken, particularly in the North Canara Zone of the Bombay State, where it is caught in relatively large numbers, especially during the south-west monsoons, *i.e.*, from July to October.

In the course of this investigation a dozen specimens resembling *S. sihama* were obtained in the shore-seines 'Rampani' and 'Yendi' as locally known, operated at Binge and Arge, fishing villages in the vicinity of Karwar. These, from their general appearance, could easily be assigned to the family Sillaginidæ. A critical examination with reference to their general anatomy, body measurements and fin-ray counts, however, reveals that they differ from *S. sihama* and also from the other two species referred to above in certain fundamental characters in which they conform to those of *Sillago chondropus*, Blkr. This species has not been recorded so far from Indian waters.

The main distinguishing features, in which the specimens under discussion are found to differ from *S. sihama* and to agree with *S. chondropus* are the following:

1. Eyes comparatively smaller in diameter;
2. Air-bladder absent;
3. The first spine in the paired pelvic fins thickened and consolidated with the first ray;
4. The first hæmal arch invariably found on the 13th vertebra (usually on the 15th in *S. sihama*).

Bleeker (1849) described three specimens of *S. chondropus*, measuring 134-244 mm. in length, from the Java (Batavia) sea and Weber and De Beaufort,[3] a single specimen, 135 mm. in length from Nias. The present specimens, varying within a wide range of 158-304 mm. in total length, are the first record of *S. chondropus* from the Indian waters.

The variations in body measurements and all other details will be discussed in a separate paper.

Dept. of Zoology, V. C. PALEKAR.
Institute of Science, D. V. BAL.
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THE VASIFORM ORIFICE OF ALEURODIDAE

THE most characteristic organ of the Aleurodidæ is the vasiform orifice located on the dorsal surface near the posterior end of the abdomen. It is a regular feature in the four larval instars, the pupæ as well as the adults of all species of the group. Consequently it is an important character of taxonomic value.

The form, size and position of the vasiform orifice is extremely variable, not only in the different species of the family but also among the several instars in the life-history of an individual. To mention only two examples, the

pupal case of *Dialeurodes rotunda*[1] has a small sub-semi-circular orifice with a similarly shaped operculum, entirely filling the orifice and obscuring the lingula, the tip of which may rarely be seen (Fig. 1). Whereas, in *Pealius*

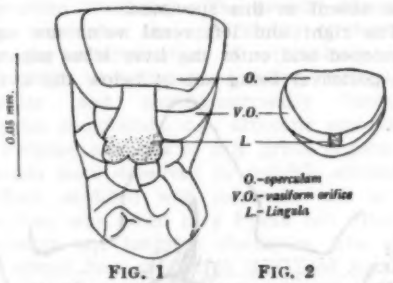

FIG. 1 FIG. 2

FIG. 1. Vasiform orifice of *Dialeurodes rotunda* (Singh), dorsal view.

FIG. 2. Vasiform orifice of *Pealius misrae* (Singh), dorsal view.

misrae[1] the vasiform orifice is sub-trapezoidal, continued caudad considerably and with a characteristic linear sculpture. Operculum is sub-rectangular, filling about three-fourth of the orifice proper; lingula cylindric with a swollen, lobed and setose distal end visible caudad of the operculum (Fig. 2).

There has been considerable difference of opinion regarding the morphology and function of the orifice. It is not an opening as believed by Imms[2] and Tullgren[3]; and it has nothing to do with secretion as postulated by Peal[4] and Bemis.[5] Its structure in the pupal and adult stages is essentially the same as shown in the larva of *Dialeurodes eugeniæ*.[6] Though called an orifice, it is merely a depression in the middle of the last but two segment of the abdomen. The floor of the depression remains in an unchitinized and elastic condition. The so-called sculpturing is merely the folds and creases of this membrane, which appears to be highly extensible. The vasiform orifice should therfore be more appropriately called the vasiform membrane. The operculum and the lingula are the last two reduced abdominal segments, lodged within the vasiform pit, the anal opening being located between the two on the dorsal side. The anus has thus shifted forwards in these insects. The opercular segment is provided with levator, depressor and rotator muscles, which impart considerable mobility to it. The disposition of these muscles, along with the elasticity of the vasiform membrane, ensures the forceful ejection of the liquid or semi-solid fæcal matter in different directions, away from the body of the animal. The variability of the vasiform membrane, operculum and lingula in different individuals may be related to the viscosity of the fæcal matter. There is no doubt that the vasiform membrane with the associated structures is an efficient mechanism for the defeciation of these insects. A full account of the pupal anatomy of one of these forms will be published elsewhere.

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ALKALI STABLE GROWTH FACTORS IN LIVER HOMOGENATES

SEVERAL authors[1,2] have noted that liver homogenates contain some alkali stable bacterial growth factors besides the vitamin B_{12} group. The alkali labile factor was reported to belong to the vitamin B_{12} group, while the alkali stable factors were not fully characterised, though their desoxyriboside nature was suggested earlier.[1,2] In this note evidence has been presented to show that two such alkali stable factors are hypoxanthine desoxyriboside and thymine desoxyriboside.

Ox liver was hydrolysed with papain by a modified method of Davis *et al.*[3] The growth factors were assayed microbiologically by the agar-cup method. The nitrogen content of the different fractions was analysed by a modified micro-kjeldahl method, and microanalysis of phosphorus was done according to Jones *et al.*,[1] while the spectrophotometric studies were carried out with Beckman ultraviolet spectrophotometer.

Whole liver hydrolysate was heated to 100° C. at pH 7·0 for about 30 minutes, and then cooled and dialysed against distilled water asceptically. The undialysed fraction contained no growth factor. The dialysate was then passed through a column of the hydrogen form of Zeo-Karb — 215, when all amino acids, lower peptides and degradation products, vitamin B_{12} group and other basic components were adsorbed completely, leaving the alkali stable growth factors with some polysaccharides in the effluent. The effluent containing the alkali stable growth factors was then treated with Darco-KB, filtered, and concentrated at low temperature under reduced pressure. It was

then analysed by paper partition chromatography, using a mixture of *n*-butanol (4 parts), ethylene glycol monomethyl ether (1 part), and 0·5 N aq. HCl (2 parts) as the solvent. Three alkali stable growth factors with R_f (*a*) 0·43, (*b*) 0·73, and (*c*) 0·78 were detected on the chromatogram, and were eluted with water. The ultraviolet absorption maximum ($\epsilon_{max.}$) of these three fractions were at 254 mμ, 260 mμ and 265 mμ respectively. Both the fractions (*a*) and (*c*) contained desoxyribose, as confirmed by diphenylamine reaction (Dische, $\epsilon_{max.}$ at 600 mμ). None of the fractions contained phosphorus, while fraction (*b*) has not yet been fully investigated. Aliquots of fractions (*a*) and (*c*) were dried and the residues hydrolysed with formic acid (98/100%) at 175° C. for 60 minutes and then rechromatographed, and the spots detected and eluted with water. The eluate from (*a*) was identified with pure hypoxanthine (National Biochemical Corporation, Ohio), having similar R_f values, UV-absorption curves and similar $(\gamma N/ml.)/\epsilon_{max}$ ratios. Similarly the eluate from (*c*) was identified with thymine. Further, thymine desoxyriboside which was prepared from purified herring roe desoxyribose nucleic acid according to Waldhof[5] was identified on the chromatogram with fraction (*c*).

The author wishes to express his thanks to Mr. S. Ghosh for technical help and to Drs. U. P. Basu and A. N. Bose for their interest in this investigation.

Bengal Immunity Res. Inst., S. K. Dutta.
Calcutta-16, *November* 1954.

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SOME ABNORMAL FEATURES IN THE VENOUS SYSTEM OF THE GARDEN LIZARD, *CALOTES VERSICOLOR*

During the course of study of the internal anatomy of the garden lizard the following abnormal features were observed in the venous system of one specimen (Fig. 1).

The caudal vein, instead of bifurcating at the base of the tail into two pelvic veins, runs across the ventral surface of the right kidney very close to its inner margin; and before leaving the latter it gives a branch to the left kidney. The left femoral and sciatic join together and enter the left kidney. The right pelvic, after being joined by the right femoral and sciatic, proceeds forwards through the body-wall up to the forelimb and there bends inwards and enters the right precaval. The left pelvic vein and the abnormal vein are thus absent in this specimen.

The right and left renal veins are equally developed and enter the liver lobes separately, the postcaval being absent below the liver. A single postcaval however emerges out anteriorly from the liver and enters the heart.

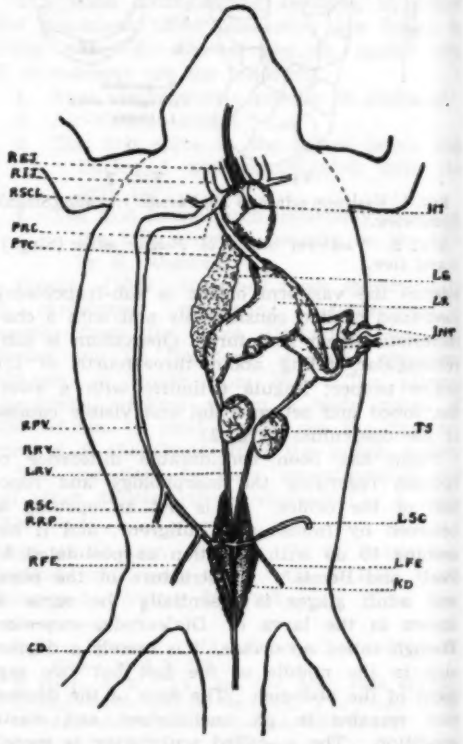

Fig. 1. CD–caudal vein. HT–heart. INT–intestine. KD–kidney. LFE–left femoral vein. LG–lungs. LR–liver. LRV–left renal vein. LSC–left sciatic vein. PRC–precaval vein. PTC–post-caval vein. REJ–right external jugular vein. RFE–right femoral vein. RIJ–right internal jugular vein. RPV–right pelvic vein. RRP–right renal portal vein. RRV–right renal vein. RSC–right sciatic vein. RSCL–right subclavian vein. TS–testis.

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January 3, 1955.

ESTIMATION OF ORGANIC COMPOUNDS WITH THE PLATINUM-TUNGSTEN BIMETALLIC ELECTRODE SYSTEM

THE Pt-W bimetallic electrode system[1] has been successful in electrometric inorganic oxidation-reduction titrations. The present communication reports on the applicability of the system for the determination of equivalence in the estimation, by the bromination method,[2,3] of readily and stoichiometrically brominated organic compounds, *e.g.*, aromatic amines, etc.

Weighed amounts of A.R. grade organic compounds were dissolved in suitable solvents. An aliquot, acidified with sulphuric acid to a 2N solution, was taken in a Pyrex cell fitted with platinum and tungsten electrodes. The electrical circuit was similar to that used by Gay,[1,4] and consisted of a 1·5 volt cell with its negative pole connected to the tungsten electrode, a 1 kΩ fixed resistance, a 200Ω variable rheostat and a suitably shunted galvanometer, all in series. Galvanometer deflexions were noted after successive additions, from a burette, of small amounts of a standard 'bromine mixture' ($KBrO_3$ + KBr) and thorough mixing. Observations were continued, in each case, beyond the anticipated point of equivalence.

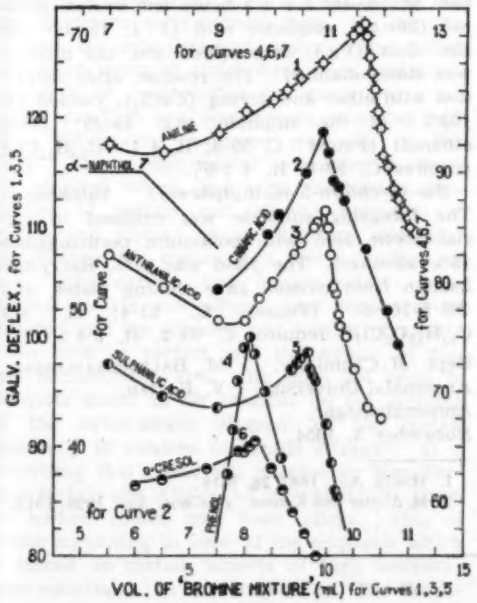

FIG. 1. Pt-W Electrode System for the Determination of Equivalence in the Estimation of Organic Compounds by the Bromination Method.

Representative results are shown graphically in Fig. 1. It will be seen that the breaks, which correspond to points of equivalence, are markedly defined. The amounts of the organic compounds taken and those calculated are shown in Table I.

TABLE I

Substance	Solvent	Weight (g)		
		Present	Found	Error
Aniline	Dil. H_2SO_4	0·8860	0·8863	+0·0003
Anthranilic acid	do	0·3387	0·3386	−0·0001
Sulphanilic acid	do	0·2670	0·2677	+0·0007
Phenol	Water	0·1528	0·1530	+0·0002
o-Cresol	do	0·2626	0·2616	−0·0010
α-Naphthol	Acetic acid	0·0481	0·04822	+0·00012
Cinnamic acid	Alcohol	0·6952	0·6947	−0·0005

It is evident from an examination of data in Table I that the error is generally far less than that usually met with in ordinary estimations; this is indicative of the fact that the Pt-W electrode system is applicable for the quantitative determination of organic compounds by the bromination method.

Grateful thanks of the authors are due to Prof. S. S. Joshi for his kind interest in the work.

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J. GOPALA KRISHNA MURTY.
January 9, 1955. S. R. MOHANTY.

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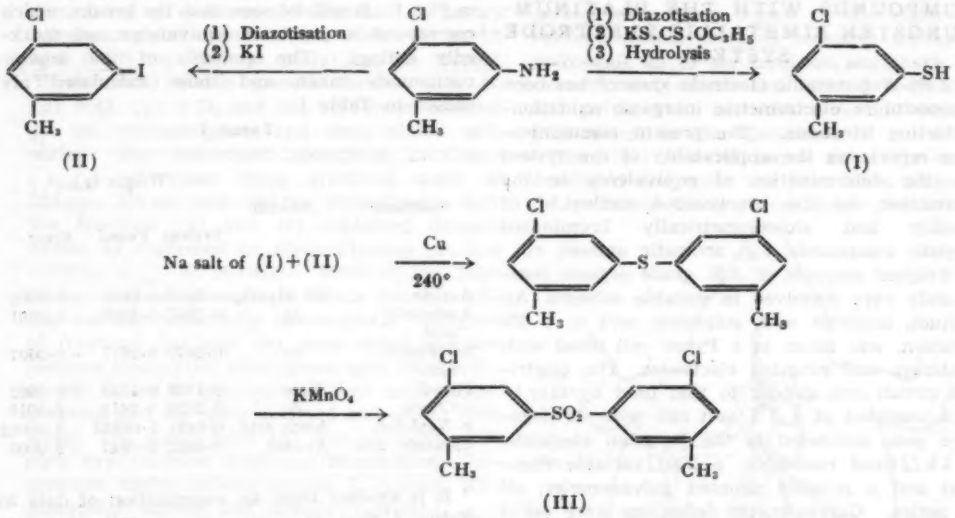
SYNTHESIS OF BIS-(3-CHLORO-5-METHYLPHENYL) SULPHONE

RECENTLY we prepared some bisamisoaryl sulphones having possible antituberculous and antileprous activity. While elucidating their structure we had occasion to synthesise bis-(3-chloro-5-methylphenyl) sulphone (III). The important steps involved in its synthesis are shown in the chart and the relevant experimental details are herein reported.

3-Chloro-5-mercaptotoluene.—9 g. of 3-amino-5-chlorotoluene[1] was diazotised using 40 c.c. of hydrochloric acid (1 : 1) and 6 g. of sodium nitrite. The diazonium salt solution was added



dropwise with continuous stirring to a solution of potassium ethyl xanthate (12 g. in 15 c.c. of water) kept at 40-45°. After the addition was over, the mixture was kept at the same temperature for one more hour and the resulting red oil was extracted with ether and dried over calcium chloride. After removing the ether, the oil was dissolved in ethanol (60 c.c.), brought to reflux on a water-bath, potassium hydroxide pellets (20 g.) were gradually added and heated for 8 hours. At the end, about 50 c.c. of ethanol was removed by distillation and the residue was dissolved in the minimum amount of water. The solution was acidified with sulphuric acid (1 : 1), mixed with zinc dust (5 g.) and steam-distilled. The thiophenol which distilled over, after extraction with ether and drying over anhydrous magnesium sulphate, weighed 5·7 g. (57%). It boiled at 94-95°/8 mm.; n_D^{27} 1·5875 (Found: C, 52·8; H, 4·6. C_7H_7ClS requires C, 53·0; H, 4·4%).

Its *benzoyl derivative*, on recrystallisation from methanol, melted at 77·5-78·5° (Found: C, 64·4; H, 4·5. $C_{14}H_{11}OClS$ requires C, 64·0; H, 4·2%).

Bis-(3-chloro-5-methylphenyl) Sulphide.—Sodium (0·6 g.) was dissolved in absolute ethanol (15 c.c.) and the solution was mixed with 3-chloro-5-mercaptotoluene (3·8 g.). After removing the ethanol by distillation, the residue was mixed with 3-chloro-5-iodotoluene[2] (6 g.) and copper powder (0·2 g.), heated in an oil-bath at 240-45° for 3·5 hours and cooled. Ethanol (20 c.c.), sulphcric acid (1 : 1; 10 c.c.) and zinc dust (1 g.) were added and the mixture was steam-distilled. The residue, after extraction with ether and drying ($CaCl_2$), yielded 4 g. (59%) of the sulphide, m.p. 34-35° (from ethanol) (Found: C, 59·4; H, 4·1. $C_{14}H_{12}Cl_2S$ requires C, 59·4; H, 4·2%).

Bis-(3-chloro-5-methylphenyl) Sulphone.—The foregoing sulphide was oxidised in glacial acetic acid with potassium permanganate (5% solution). The yield was 97%. Recrystallisation from ethanol gave shining plates, m.p. 163·5-164·5° (Found: C, 53·4; H, 3·9. $C_{14}H_{12}O_2Cl_2S$ requires C, 53·3; H, 3·8%).

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V. Baliah.

November 3, 1954.

1. Honig, *Ber.*, 1887, **20**, 2419.
2. McAlister and Kenner, *J. Chem. Soc.*, 1928, 1915.

REVIEWS

Engineering Metallurgy. By E. M. H. Lips. (Phillips' Technical Library), 1954. Pp. xv + 250. Price not given.

The author of this hand-book is Head of the Metallurgical Laboratories of Phillips Lamp Works at Eindhoven where his duties bring him into daily touch with a variety of design problems in many branches of engineering. He is thus in a position to know where the advice of the metallurgist is most needed by the engineer. In preparing this book he has clearly profited to the full from his experience. Metals are of course amongst the main materials of construction used by the engineer and many attempts have been made to present the engineer what he needs to know about metals. The present book is a conspicuously successful attempt in this direction in spite of a few minor flaws. The judgment shown in selecting the field to be covered is particularly commended. Dr. Lips has recognised that the engineer wants to know what to expect of his metals and how to prepare them by heat-treatment or otherwise to ensure that he will get the maximum service from them. He requires a basis for selection and design using metals and alloys some of which have been traditional materials of construction for many years but some of which are new-comers into the field. This information is given concisely in this book. The subject-matter is treated in several chapters which deal with mechanical properties of metals and alloys; corrosion of metals and alloys; phase diagrams and their significance for metals and alloys; alloys of iron with carbon and other metals; non-ferrous metals and alloys; heat treatment of metals; and the working and joining of metals.

No book is perfect and the author of this one occassionally errs. He does not seem to be quite sound in his remarks on the meaning of the stress/strain diagram of the metals especially in relation to tensile strength. It is surprising that under the chapter on Non-Ferrous Metals and Alloys, no information is given on nickel, cobalt and their alloys. This is rather surprising in view of the emphasis which is placed on certain aspects of high temperature materials. In the chapter on 'The Working and Joining of Metals' inadequate attention seems to have been given to welding.

The book is a translation and the author has been very well served by his translator. The compositors have not done quite so well, a number of misplaced letters marring what is otherwise a finely designed and printed book which will add to the excellent reputation already enjoyed by Phillips' Technical Library. As pointed out in the preface, the book is of special value to students preparing for such examinations as Higher National Certificate Courses in Production Engineering. Its value is however not limited to students: it will certainly be enlightening and helpful to many qualified engineers and metallurgists.

E. H. BUCKNALL.

Luminescence (with Particular Reference to Solid Inorganic Phosphors). (*British Journal of Applied Physics, Supplement No. 4.*) (The Institute of Physics, London), 1955. Pp. 111. Price 25 sh.

The papers published in this supplement, with the discussion on them, comprise the proceedings of the Conference held in Cambridge on 7-10, April 1954. The Conference was organized by the Committee of the Electronics Group of the Institute of Physics and was the first major discussion on the subject of luminescence since a Conference held in Oxford in 1938; the emphasis was upon solid inorganic phosphors. Twenty-one papers were presented excluding the two introductory papers. The subject-matter of the papers may be summarised as follows:—

As a result of rapid developments in luminescence during war-time and after, a large number of new phosphors have been discovered with the use of large proportions of structure modifiers like fluorine and titanium, and alkali metals like lithium and sodium. Among the new phosphors special importance is attached to calcium halophosphates activated singly by antimony or doubly by antimony and manganese, tin-activated pyro- and tetraphosphates of strontium and barium; and a group of manganese and cerium manganese activated silicates containing lithium and some phosphors excited by ultra-violet radiation of short wave-length, namely, boron phosphate activated by thallium and some arsenate analogues of the halophosphates and self-activated

vanadates excited by ultra-violet radiation of long wave-length. The preparation as well as the important characteristics of these phosphors have been discussed. The mechanism of excitation of luminescent solids by an applied potential, or what is called electro-luminescence, has met with spectacular advances in the practical field, for example, in the construction of electro-luminescent lamps. Several characteristics of the electro-luminescent phosphors have been studied extensively like their brightness, waveforms and the correlation between dielectric properties, rectifier action and photo-conductivity, etc.

Another important advance is the development of sensitised luminescence. Here the luminescent phosphors contain an activator proper, which is responsible for the main emission band and which has no absorption band in the spectral range desired for excitation and consequently shows no fluorescence under radiation by light of that wave-length, and a sensitizer which serves to introduce an absorption band at the desired location. The processes of energy-transfer from the sensitizer to the activator has also received considerable attention.

The present theories about luminescence are not very satisfactory. Two models have been mainly assumed for an explanation of the observed phenomena, one, the configuration co-ordinate model and the other, the energy band diagram; but both appear to be rather crude, considering the basic assumptions regarding electron transitions, positive hold migration trapping and retrapping, etc. A new theory has been proposed about the luminescent centre in which the compensation of charge by lattice vacancies or by activator ions is localised in the vicinity of the activator ions. A general theory has also been proposed to correlate the conductivity and luminescence measurements with the energy states of a crystal lattice perturbed by impurities or defects and to the electronic transition probabilities between these various states.

The importance of X-ray analysis of phosphors and some other physical measurements and also of the controlled method of preparation are outlined. Radioactive tracers are of very great importance in controlling the efficiency of purification of the raw materials, and they are finding more and more use in the preparation and study of the luminescent solids. In the case of photo-conducting phosphors, the luminescence and photo-conductivity are complicated in non-linear functions of the exciting intensity. An account is given of the types of non-linear behaviour and the generality of their occurrence with different models.

The book will be useful not only to persons working on solid state physics but also to physicists in general. R. S. K.

Ion Transport Across Membranes. Edited by Hans T. Clarke. (Academic Press), 1954. Pp. xi + 298. Price $7.50.

This volume is a collection of fourteen papers contributed by various investigators to a symposium on the role of proteins in ion transport across membranes, sponsored by the National Science Foundation in 1953.

The diversity of biological membranes, the nature and mechanism of the ion transport through living cell membranes by active transport as distinct from simple diffusion (passive) are well discussed by Ussing. Huxley describes the electrical processes associated with conduction of nerve impulse, namely, the ionic movements and ionic concentration gradients generating bioelectric potentials and also clearly points out the gaps in the system, such as the molecular mechanism of the striking changes in permeability and the utilisation of metabolic energy to charge the ionic battery. The possible role played by acetylcholinesterase and ATP in this regard, and the existence of so-called receptor protein endowed with certain special properties as postulated by Nachmansohn have been further substantiated by spectrophotometric and light scattering studies. The ion permeability of the red cell to cations and anions and the mechanism of specific ion accumulation are discussed in the fifth paper. The mechanism of electrolyte transport in the kidney (as distinct from nerve, muscle and red cell) for regulating excretion involving filtration, reabsorption, secretion and ion exchange have been dealt with by Mudge.

A general theory has been outlined and model equations worked out by Eyring *et al.* to treat the known facts about the permeability and electrical potentials developed. The membrane potentials are shown to depend on temperature, pressure, composition and, in particular, on the thermodynamic state of the membrane component. The ion exchanger membranes are shown to be very useful as electrodes at which there is no oxidation or reduction and no restriction to special classes of ions except as to size, and may serve as useful models for physiological membranes. The fundamental electrochemistry of model membranes of porous character is exhaustively dealt with by Souner *et al.*

Two very important equilibrium problems, viz., the Donnan membrane equilibrium and the binding of ions or molecules by protein molecules in solution are discussed by Hill, using the very elegant method of McMillan and Mayer. The intensive researches conducted by Edsall *et al.* on a highly specific and remarkable dimerization reaction occurring by the interaction of serum mercaptalbumin with mercury and organic mercurials, throwing further light on the detailed pattern of molecular structure of these particular proteins are reported in the twelfth paper. The reversible type of metal protein reactions have been reviewed by Gurd indicating the alternative types of interactions: (*a*) binding of metal to individual groups in a protein molecule, (*b*) cross-linking in an intermolecular complex, and (*c*) cross-linking in an intramolecular complex. Some general conclusions have also been drawn regarding the solubility behaviour of metal-protein complexes. In the last paper, Debye presents certain additional quantitative aspects of the effect, showing that polymer solutions adjust the concentration distribution of the solute when subjected to influence of inhomogeneous electric fields.

This publication is authoritative and will be welcomed by all biologists, physical chemists and protein chemists.

Y. NAYUDAMMA.

High Polymers Celluose and Cellulose Derivatives, Vol. V, Part II. Edited by Emil Ott, Harold M. Spurlin and Mildred W. Grafflin. (Interscience Publishers, Inc.), 1954. Pp. xvi + 437. Price $ 11.50.

Part II of the book deals largely with problems connected with the industrial processing and utilisation of cellulose. The four chapters in this part deal with preparation of cellulose from its natural sources, bleaching and purification of wood cellulose, properties and treatment of pulp for paper, and derivatives of cellulose.

The chapter on preparation of cellulose from its natural sources has been rearranged and largely rewritten to include recent theoretical work on the theory of sulfite process and kraft process. The discussion on testing of the properties of pulp to predict its end use has also been extended. In the section on cotton linters have been added two useful flow sheets for linters purification process and for chemical cotton drying process. The section dealing with pulp-making from grasses and cereal straws is fundamentally unchanged. Chapter 8 dealing with the properties and treatment of pulp for paper is a new addition. This chapter deals with the various properties of the pulp, details of the beating process including a description of beating equipment and their action on the pulp, various theories of beating and its results. The chapter ends with a discussion of the chemical testing of pulp and its limitations in evaluation of pulps for paper-making.

Chapter 9 on the derivatives of cellulose has been largely rewritten. It starts with a discussion of theoretical and experimental methods of determining the distribution of substituents in cellulose derivatives which is an important technical problem. This is followed by a masterly treatment of the physical and chemical structure of cellulose and its effect on the rate and degree of substitution.

The section on inorganic esters in this chapter is essentially unchanged though brought up to date, while in the section on organic esters some interesting charts on the relation between composition and properties of cellulose triesters and mixed aliphatic esters have been added. The discussion on alkali derivatives includes a brief but clear account of technical mercerisation and the resulting changes in properties of the fibres. The section on cellulose esters has been considerably expanded and rewritten to include more details of preparation and properties of methyl and ethyl celluloses and brief notes on the more recent hydroxyalkyl celluloses, cyanoethyl celluloses and carboxymethyl celluloses. Similarly in the section on xanthates, the reaction mechanism of cellulose xanthate and viscose formation is discussed in greater detail. A new section has been added to this chapter. This deals with degradation of cellulose derivatives and gives an interesting discussion of the microbiological, hydrolytic and oxidative degradation of water-soluble and organo-soluble derivatives of cellulose. With the increasing industrial importance of cellulose derivatives this added information is certainly very useful.

P. C. MEHTA.

A Short Text-Book of Colloid Chemistry. By B. Jirgensons and M. E. Straumanis. (Pergoman Press, London), 1954. Pp. xvi + 420. Price 40 *sh.*

The book under review is a revised version of the authors' 'Kurzes Lehrbuch der Kolloidchemie' published by Bergmann and Springer in 1949. The book is divided into two parts.

In the first part comprising three chapters, the fundamental terms, classifications and elementary laboratory methods are outlined. Inorganic and organic colloids, globular and fibrous colloids, molecular and micellar colloids and solvation of colloids are very elegantly explained for a beginner. Simple experimental procedures like filtration and ultra-filtration, diffusion and dialysis, flocculation, viscosity, optical investigations, etc., are also described. The second part, which consists of sixteen chapters, contains an elaborate discussion of classical and modern techniques of light scattering, electrophoresis, ultracentrifugation, viscosity, electron microscopy, X-ray analysis, etc.

The kinetic properties of the disperse systems like the Brownian movement, etc., interfacial properties of colloids, optical properties like opalescence and reflection turbidity, light scattering, optical rotation and anisotropy and the electrical properties like electrophoresis, electro-osmosis and the charge of colloids and viscous properties of colloidal systems are lucidly explained in the book. Determinations of particle size and particle shape by the familiar techniques have been described. The electron microscope methods and x-ray methods with a number of interesting illustrations are given. The preparation of colloids by dispersion methods and condensation techniques are certainly a novel feature of this book. Coagulation, stability and protection of lyophobic colloids and solvation, flocculation, micellar aggregation, etc., of lyophilic colloids are some other interesting topics dealt with in this book. The concluding chapters deal with gels, jellies, membranes, emulsions, foams, aerosols and glass.

With its wealth of experimental details and theoretical explanations this book should prove suitable not only to Honours students in chemistry but also to research workers in various branches of natural sciences which include medicine, pharmacy, etc., in all of which knowledge about colloids is so very essential.

M. SANTHAPPA.

Tables of Error Function and Its Derivative. (National Bureau of Standards, Applied Mathematics Series 41.) (Order from Government Printing Office, Washington-25, D.C.). Pp. 302. Price $3.25.

The error function, or probability integral, in one form or another, has enjoyed a remarkably wide application in many diverse branches of science—from problems in refraction, the conduction of heat, and other fields of physics, to a variety of problems in the theory of probability and mathematical statistics.

Tables of the error function have been compiled before. The most extensive to date have been those due to Burgess, published in Scotland in 1898. Since then a variety of additional tables have been published. The present tables extend the range of all existing tables, and provide a smaller tabular interval and provision has been made to facilitate interpolation, both direct and inverse, by the user of the tables.

Tables of Functions and of Zeros of Functions. (National Bureau of Standards, Applied Mathematics Series 37.) (Order from the Government Printing Office, Washington-25, D.C.). Pp. 211. Price $2.25.

Prompted by a continuing demand for previously issued short tables of the National Bureau of Standards Computation Laboratory, NBS has decided to collect together groups of related short tables and issue them in convenient form. This volume is the first of certain projected numbers in the NBS Applied Mathematics Series to bear the subtitle, *Collected Short Tables of the National Bureau of Standards Computation Laboratory.*

The present volume presents ten tables of special functions, such as integrals of the Bessel functions J_0 and Y_0, exponential integrals, Struve functions, and values of $x^n/n!$, and eight tables of zeros of functions. The latter group includes zeros of the Legendre and Laguerre polynomials together with the weight factors needed for quadrature, as well as zeros of various kinds of Bessel functions. An introduction preceding each table gives a discussion of the theory underlying the table and details of method of computation, bibliographic background, and numerical illustrations. An introduction to the whole volume describes the scope of the various tables and incorporates, as a special feature, a reference to the principal review of each table.

Chemical Specificity in Biological Interactions, Vol. III. (*Harvard University Memoirs.*) Edited by Frank R. N. Gurd. (Academic Press), 1954. Pp. xv + 234. Price $6.0.

The series of seminars held in 1952 at Harvard University form the basis for the third volume of Harvard Memoirs, which maintains the high standard of the two previous volumes. The ten articles in this book cover a wide range of topics related to the study of chemical forces underlying biological interactions with special

reference to proteins. The first chapter by the late E. J. Cohn deals with the specific reactions of proteins with metals as the basis for a new technique of protein fractionation. The present methods for the isolation of individual proteins are chiefly empirical. Though the value of the new technique still remains to be established, a more detailed description of the technique and equipment in a subsequent volume of the series will be awaited with interest. In the second chapter the effects of radiation on proteins and living tissues are briefly outlined by Shields Warren.

The next two articles are on steroids, one by R. B. Turner on the configuration of steroids and their binding by proteins and the other by E. B. Gallagher on the biochemistry of steroid hormones. V. du Vigneaud's description of the purification and analysis of vasopressin and oxytocin will be of considerable interest in view of his subsequent determination of structure and synthesis of these polypeptide hormones. The application of ion-exchange chromatography to the isolation of *a* and *b* nucleotides and the structure of ribonucleic acid are outlined by Waldo E. Cohn, whose pioneering work has led to rapid advances in this field. The remaining four chapters of the book will be of special interest to the protein chemist. The formation and stability of metal complexes are ably discussed by C. D. Coryell and G. Schwarzenbach. The reactions of metals with small molecules in relation to metal-protein interactions are reviewed by J. Schubert, and the interaction of proteins with small molecules and ions are discussed by G. Scatchard *et al.* This brief summary will indicate that this volume should be of interest both to the biochemist and to the specialist in protein chemistry.

The typography and get-up of the book are of high standard. The "'chair and boat" structures of cyclo-hexane on page 34 are, however, wrongly numbered. It would be of value to amplify the incomplete legends for figures 3 and 4 in Chapter I.

V. JAGANNATHAN.

Text-Book of Zoology, Vol. 1. By D. Mukherjee. (New Book Stall, Calcutta), 1954. Pp. x + 556. Price Rs. 25.

Prof. Mukherjee is a teacher of long experience in the Calcutta University and this book has been written with a view to meeting the needs of students preparing for the I.Sc. and B.Sc. Examinations, primarily in the Calcutta University but generally in all Indian Universities. The book is in three parts, apparently to be included in two volumes. The first volume, under review, includes two of them; the first part deals with the general principles of biology, like Structure and Composition of Protoplasm, Cytology, Genetics and Evolution, Embryology, Histology, Classification and Distribution of Animals. The second part deals with the structure and classification of the non-chordata. The second volume, to be published, will deal with the chordata.

This is a refreshingly new treatment. In the first 150 pages is dealt almost all the general principles underlying the existence and maintenance of living organisms on this earth, their chief characters and manifestations, their general structure, the manner in which they maintain themselves and occupy the present position in this planet. Useful chapters on the use and care of the microscope and laboratory methods are provided.

There are two accepted methods of teaching Zoology: the 'type method' and the 'comparative method'. Both have their advantages and drawbacks and with judicious treatment, both can bring home to the student the underlying idea of the great variety and richness of animate nature and emphasise the basic evolutionary concept that a study of biology should provide. No teaching of Zoology is successful except on the basis of the message of evolutionary thought and none useful which fails to bring home to the student the cardinal principle of organic evolution. Prof. Mukherjee adopts the type method, but he does not neglect the great diversity of animal organization and, in the opinion of the reviewer, very effectively brings to the mind of the reader, the illimitable fascination of the study of animal life. The descriptions are clear and the illustrations effective.

It seems doubtful, however, if the book will be in the hands of as many students as would desire to have it—the cost (Rs. 25) is rather high. But with the several-fold increase in book-printing and preparation costs during recent years, this seems to a certain extent unavoidable. We would recommend it to all students of biology in the universities as well as to such laymen that wish to acquaint themselves with the life and characteristics of animals.

B. R. S.

Books Received

Abstract Bibliography of Cotton Breeding and Genetics, 1900-50. By R. L. Knight. (Commonwealth Bureau of Plant Breeding and Genetics, England), 1954. Pp. 256. Price 21 *sh.*

Liquid—Liquid Extraction. By L. Alders. (Elsevier Publishing Co.), 1955. Pp. x + 206. Price 32 *sh.*

Advances in Virus Research, Vol. II. Edited by K. M. Smith and M. A. Lauffer. (Academic Press), 1954. Pp. x + 313. Price $ 7.00.

Advances in Carbohydrate Chemistry, Vol. 9. Edited by L. Wolform. (Academic Press), 1954. Pp. xviii + 426. Price $ 10.50.

Chemistry and Chemical Technology of Cotton. Edited by Kyle Ward Jr. (Interscience Publishers, Inc.), 1955. Pp. xix + 782. Price $ 20.00.

Optical Glass Working. By F. Twyman. (Hilger & Watts Ltd.), 1955. Pp. viii + 275. Price 24 *sh.*

Frontier to Space. By Eric Burgess. (Chapman & Hall), 1955. Pp. xvi + 174. Price 21 sh.

Relativity for the Layman. By James A. Coleman. (William Frederick Press, New York), 1954. Pp. 131. Price $ 2.75.

A Symposium on Amino Acid Metabolism. Edited by W. D. McElroy and H. Bentley Glass. (Johns Hopkins Press, Baltimore), 1955. Pp. xvi + 1048. Price $ 12.50.

SCIENCE NOTES AND NEWS

First Congress on Theoretical and Applied Mechanics

The First Congress on Theoretical and Applied Mechanics will be held during November 1955 at the Indian Institute of Technology, Kharagpur. Exact dates will be announced later. It will be the first congress of the kind to be held in this country to bring together engineers, mathematicians, physicists and statisticians who are interested in applied mechanics. Dr. K. S. Krishnan, Director, National Physical Laboratory will preside over the Conference and Dr. S. R. Sen Gupta, Director, Indian Institute of Technology, will be the Chairman of the Reception Committee.

The Congress will be on a research level. Papers may be communicated and read on any of the following subjects: Elasticity—Plasticity—Rheology; Fluid Mechanics—(Aerodynamics—Hydrodynamics); Mechanics of Solids—(Ballistics—Vibrations—Friction—Lubrication); Statistical Mechanics—Thermodynamics—Heat Transfer; Mathematics of Physics and Mechanics—Methods of Computation. Further details can be had from Dr. B. R. Seth, Organizing Secretary, First Congress on Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur.

Madras University Prizes

The Maharaja of Travancore-Curzon Prizes for 1955-56: Two prizes (one for Physiology and one for Geology) will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras University on any topic dealing with the subjects. The value of each prize is Rs. 250. Competitors should submit their theses so as to be received by the Registrar not later than the 1st March 1956.

Sir William Wedderburn Prize, 1956: The prize which will consist of books of the value of Rs. 45, will be awarded to the student, who having qualified in Chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously, has shown aptitude for research. A thesis on any research work conducted by the student should be submitted with the application so as to be received by the Registrar, Madras University, not later than the 30th April 1956.

Journal of Family Welfare

A bimonthly Journal devoted to family welfare has been started under the editorship of Dr. A. P. Pillay, in Bombay. The appearance of the Journal is timely, and it caters to a very wide public as may be judged from the contents of the inaugural number: Marital maladjustments and marriage counselling, The Special Marriage Act of 1954, The so-called 'artificial' insemination, Differential fertility and its effect on community welfare, Family planning in India, Assessment of sperm density from dry smears of semen, An approach to the problem of infertility, Sterilization in the male. The first three numbers which have been received make it clear that it has a very useful part to play in educating the lay public in regard to the personal, marital and sociological aspects of family life, and we extend to the Journal our heartiest good wishes. Copies may be ordered from: The Editor, *Journal of Family Welfare,* 378, Hornby Road, Bombay-1.

Virology

Academic Press Inc., Publishers, announce a new Journal, *Virology*, with Dr. George K. Hirst, Public Health Research Institute of the City of New York, Inc., as the Editor-in-Chief. The purpose of *Virology* will be to publish articles on the biological, biochemical and biophysical aspects of the subject, stressing contributions of a fundamental rather than applied nature. It is hoped that the Journal will contribute to the integration of virus science by providing a ready introduction to all its fields.

It is planned to publish one volume per year. Volume 1, Number 1 is scheduled for release in May 1955. Subscriptions for the Volume 1, priced at $ 9.00, should be sent to the Publishers, Academic Press, Inc., 125 East 23 Street, New York 10, New York.

Inventory of Teaching Equipment for Medical Schools

A detailed inventory of the equipment needed to set up a medical school is now available as the result of a joint undertaking by the World Health Organization and UNESCO. This important reference manual is intended chiefly for use in new medical schools, but is also expected to be of help to existing medical schools which plan to re-organize their teaching departments on more modern lines.

This is Part V (Medical Sciences), Volume III of the UNESCO series "Inventories of Apparatus and Materials for Teaching Science" and contains lists of equipment used in the instruction of medical students in 8 subjects: (1) Anatomy, (2) Bacteriology (Microbiology), (3) Biochemistry, (4) Histology, (5) Morbid Anatomy (Pathology), (6) Pharmacology, (7) Physiology, and (8) Preventive and Social Medicine (Hygiene and Public Health).

The publication is priced at $ 2.75 and can be had from any of the national distributors of UNESCO Publications.

Aluminium in Australian Trees

The surprising discovery that certain trees in Australia and New Guinea accumulate aluminium has been reported by the Plant Industry Division of the Australian Commonwealth Scientific and Industrial Research Organisation. The Division examined about 80 species, and found that the aluminium exists in the form of compounds, hard white masses in the timber, also in the bark and the leaves, the trees apparently absorbing it from the soil.

When considerable quantities were found in a tree in Queensland, it was first considered a freak, but examination of other species, including coachwood, prickly ash, smooth-flowered nut trees, and Queensland blue beech, soon showed that various trees had accumulations.

It is not known whether the trees absorb the aluminium willynilly from the soil, or whether it plays some part in their growth. No trees in the dry inland area of Australia accumulate aluminium. It is in the rain forest areas that the research officers have found the compounds of the metal, together with organic acids.

World Health Day, 1955

"Clean Water Means Better Health" is the theme chosen for this year's World Health Day, 7 April, the seventh anniversary of the day on which the Constitution of the World Health Organization officially came into force. The series of feature articles issued by the WHO on the occasion have been written by authorities on various aspects of water supply, water protection or purification, and serve to emphasize the Organization's concern for the improvement of sanitation programmes, and to highlight a problem which is causing serious anxiety to health authorities in countries all over the world.

Radiocinematography

A documentary picture made by Dr. Pierre Thevenard of the Pasteur Institute in Paris, is the first successful example of "radiocinematography", or filming with X-rays. After previous attempts in the United Kingdom and Germany had failed, Dr. Thevenard decided to pursue the experiments and to produce a 35 mm. film on the biological history of the bluebottle (*Calliphora erythrocephala*).

Special camera equipment had to be assembled with strong magnifying power and a recording range of between 24 pictures a second and one picture every ten minutes. By means of irradiation through the aperture, and without either fluorescent screen or lenses, Dr. Thevenard was able to study the metamorphosis of the insect and the processes involved in the passage of food through its body. Unlike ordinary microphotography, X-ray filming retains the three dimensions.

Apart from its high artistic quality, the film emphasizes the exceptional value of radiocinematography as an instrument for scientific research. The various phases of the metamorphosis revealed by the X-rays provide evidence of hitherto unknown phenomena.—UNESCO.

The Institution of Telecommunication Engineers

The Institution of Telecommunication Engineers, inaugurated in New Delhi, India, in November 1953, has already more than a thousand members on its rolls and this figure is increasing rapidly. Its membership is drawn from various government operated communication agencies, the three Defence Services, Research Institutes and Industry. Run by a governing council of 24, the Institution, like most professional bodies, prescribes minimum educational qualifications and experience for entry into its several categories, but direct admission into the lower categories is also possible by passing the examinations which are to be conducted by it. A quarterly Journal of the Institution of Telecommunication Engineers is proposed to be published and the first issue of the Journal is already in the Press. Talks and discussion meetings are now arranged periodically at New Delhi, the Headquarters of the Institution, and similar activities are being planned at Bombay, Calcutta, Madras, Poona, Bangalore and Jabalpur. Further particulars of the Institution can be had from: The Honorary Secretary, The Institution of Telecommunication Engineers, Post Box 481, New Delhi, India.

Blood Fractionation

It has been estimated that the human body contains 5 litres of blood of which 2·75 litres is plasma, 2·22 litres is erythrocytes, 0·02 litre is platelets and 0·01 litre is leukocytes. A blood fractionator developed under the direction of the late E. J. Cohn at Harvard University provides a continuous closed mechanical system for fractionating the blood into its components from the moment it is drawn from the vein.

In this apparatus calcium is removed by passage through an ion-exchange resin which gives sodium and takes up calcium. Since glass and rubber are destructive, the component parts are built of non-wettable plastic coated with silicone. The blood is immediately cooled to near freezing within a few seconds after being drawn. It then passes through a centrifuge. On stopping the centrifuge the erythrocytes and leukocytes fall into their respective containers. The platelets are washed from the resin column and stored in a gelatin-containing medium. Platelets can be preserved for some months but as yet leukocytes cannot be. The plasma is fractionated into 26 identifiable substances by known laboratory methods (*J. Amer. Med. Assoc.*, **1954, 156, 772**).

Rapid Drying Coating Materials

A process for rapid hardening of inks, paints or other coating materials made from drying oils or reactive resins by means of sulphur dichloride has been developed by the Armour Research Foundation.

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Awards of Research Degree

The Muslim University, Aligarh, has awarded the Ph.D. Degree in Zoology to the following candidates for theses indicated against each: N. M. Antony—"*Avitellina centripunctata* Studies in Morphology and Life-Cycle"; S. Johnson—"Studies in Morphology and Life-Cycle of *Physaloptera varani*"; and S. Shujaatul Akbar—"Morphology and Life-History of *Leptocorisa varicornis*, a Serious Pest of Paddy Crop in India".

The Osmania University has awarded the Ph.D. Degree in Physics to Shri D. S. R. Murty for his thesis entitled 'Directional Studies in Cosmic Rays at Hyderabad, India', and to Shri V. V. Varadiah for his thesis entitled 'Viscosity and Light Scattering Studies on High Polymer Solutions'.

The Andhra University has awarded the D.Sc. Degree in Chemistry to Sri. A. Purushottam for his thesis entitled 'Studies on Rare Earths'.

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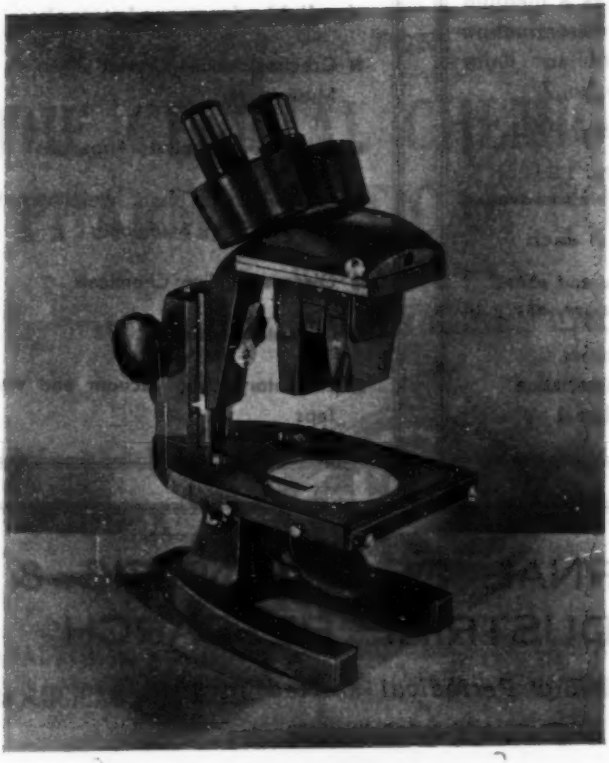

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